TIMBER SUPPLY BRANCH

TIMBER SUPPLY REVIEW

KingcomeTimber Supply Area Analysis Report

November 2001

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Kingcome Timber Supply Area Analysis Report

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Preface

This report contains a timber supply analysis and a socio-economic analysis and is part of the provincial Timber Supply Review carried out by the British Columbia Forest Service. The purpose of the review is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in timber supply areas (TSAs) and tree farm licences (TFLs) throughout British Columbia.

To determine allowable timber harvesting levels accurately and rationally, the chief forester must have an up-to-date assessment of the timber supply, based on the best available information and reflecting current management direction. **The report that follows provides only this assessment and should not be considered as a recommendation on permissible harvest levels.**

This report focuses on a single forest management scenario — current management practices. Current management practices are defined by the specifications in management plans for the timber supply area including guidelines for the protection of forest resources, the *Forest Practices Code (FPC)* and official land-use decisions.

Focusing the assessment on the implications of current practices rather than looking at a number of different management regimes expedites the analysis process, allowing analysis of all TSAs on a regular basis. An important part of these analyses is an assessment of how results might be affected by uncertainties — a process called sensitivity analysis. Together, the sensitivity analyses and the assessment of the effects of current forest management on the timber supply provide a basis for discussions among stakeholders about alternative timber harvesting levels.

In addition to having an up-to-date assessment of timber supply when setting the allowable annual cut (AAC) the chief forester considers short- and long-term implications of alternative harvest levels, capabilities and requirements of existing and proposed processing facilities, and the social and economic objectives of the Crown. The socio-economic analysis provides the chief forester with some of the information necessary for these considerations.

This report is the third of five documents that will be released for each TSA as part of the Timber Supply Review. (The first two documents are the information report and the data package.) This document provides technical information on the results of the timber supply and socio-economic analyses. A separate document called the public discussion paper will summarize the technical information and will provide a focus for public discussions of possible timber harvest levels. The fifth will outline the chief forester's harvest level decision and the reasoning behind it.

Executive Summary

As part of the provincial Timber Supply Review, the British Columbia Forest Service has examined the availability of timber in the Kingcome Timber Supply Area (TSA). The analysis assesses how current forest management practices affect the supply of wood available for harvesting over both the short (next 50 years) and long (next 250 years) terms. It also examines the potential changes in timber supply resulting from uncertainties about forest growth and management actions. **It is important to note that the various harvest forecasts included in the report indicate only the timber supply implications of current practices and uncertainty. As such, the forecasts should be used for discussion purposes only; they are not allowable annual cut (AAC) recommendations.**

The Kingcome TSA covers about 1 139 200 hectares of area on the northern part of Vancouver Island as well as the adjacent Queen Charlotte Straits and mainland area. About 168 700 hectares (14.8% of the total area) are considered available for timber production and harvesting under current management practices. These practices follow the standards and legislation set out by the *Forest Practices Code* and various agreements and plans which guide current operational management. In the area available for timber harvesting, most of the forest is dominated by hemlock, balsam and western redcedar stands. Alder, cypress, Sitka spruce and Douglas-fir dominate smaller areas. Hemlock, alder and western redcedar are the tree species most commonly used by the forest industry from the area.

The results of this timber supply analysis suggest that, given data and management assumptions that reflect current information and practices, the Kingcome TSA can support a harvest level of 1 319 000 cubic metres per year, 5.7% below the current AAC, for the next 10 years. This harvest level has three distinct parts: 1) 15 340 cubic metres per year from red alder-leading stands, 2) 95 000 cubic metres per year from low-site cedar-leading stands, and 3) 1 208 660 cubic metres per year from coniferous stands other than low-site cedar. After one decade, the projected harvest level declines by about 10% per decade for five decades before recovering to a long-term level of 973 000 cubic metres per year.

A series of sensitivity analysis showed that data and management uncertainties affect timber supply projections to varying degrees, some with positive impacts and others with negative impacts.

Short-term timber supply (the first 50 years) is most sensitive to changes that influence estimates of timber volumes in existing stands, the size of the timber harvesting land base, and the rate of harvest that can be achieved while meeting cutblock adjacency and visual management guidelines.

Medium-term (51 to 100 years from now) timber supply is also affected by factors tested through sensitivity analysis. Specifically, changes in factors that alter either the total amount of existing volume, or the ability to access existing volume during the first 100 years affect medium-term timber supply. These include changes in: the size of the timber harvesting land base, volumes from existing and managed stands and the rate of growth of managed stands. Changes in the size of the timber harvesting land base, in timber volumes from managed stands and in the area managed under visual guidelines affect the long-term timber supply in the Kingcome TSA.

If site productivity is underestimated for existing old-growth stands as suggested by recent research, yields in managed stands could be significantly higher than in the base case harvest forecast which would significantly boost the long-term timber supply.

In summary, this analysis indicates that, based on current inventory, forest productivity estimates and the current management regime, the Kingcome TSA could support a harvest level of 1 319 000 cubic metres per year, 5.7% below the current AAC. Further reductions will be required over the next six decades. The analysis revealed that several factors related to the current forest inventory and management regime could affect timber supply. However, except for the likelihood that site index estimates for old-growth stands underestimate actual productivity, which affects timber supply primarily over the long term, there is no conclusive evidence to suggest that significant inaccuracies exist in the information used.

Executive Summary

The forestry sector is the leading employer in the Port McNeill Forest District and in 1996 supported about 40% of the labour force.

The socio-economic analysis for the Kingcome TSA indicates that the current AAC of 1 399 000 cubic metres can support a provincial total of approximately 1,700 person-years of direct employment. Residents of the TSA account for approximately 23% of this direct employment. Direct forestry sector activity in the TSA supports a further 2,070 person-years of indirect and induced employment across the province.

The base case forecast for the Kingcome TSA indicates timber supply reductions over the next several decades. By the third decade the timber supply could fall to about 1.1 million cubic metres per year. This level is similar to the average 1998-2000 harvest rate of 1 117 728 cubic metres per year. A timber supply of 1.1 million cubic metres could support about 1,360 person-years of direct employment in the province and a further 1,650 person-years of indirect and induced employment.

The current harvest has provided the provincial government with average annual revenues of $49.5 million. Fully harvesting the current AAC could increase revenues to about $62 million per year and the timber supply forecast of 1.319 million in the first decade could provide about $58 million per year.

Table of Contents

PREFACE III

EXECUTIVE SUMMARY IV

INTRODUCTION 1

1 DESCRIPTION OF THE KINGCOME TIMBER SUPPLY AREA 4

1.1 The environment 7
1.2 First Nations 9

2 INFORMATION PREPARATION FOR THE TIMBER SUPPLY ANALYSIS 10

2.1 Land base inventory 10
2.2 Timber growth and yield 19
2.3 Management practices 20
2.4 Changes since the 1995 Kingcome TSA analysis 25

3 TIMBER SUPPLY ANALYSIS METHODS 26

4 RESULTS 27

4.1 Base case forecast 27
4.2 Area, average volume and average age harvested 31
4.3 Age class profile over time 34

5 TIMBER SUPPLY SENSITIVITY ANALYSES 36

5.1 Alternate harvest flows over time 37
5.2 Sensitivity to changes in approximations used to model cutblock adjacency guidelines 38
5.3 Sensitivity to an increase in the amount of visually sensitive area 42
5.4 Sensitivity to changes in the rate of disturbance allowed in scenic areas 43
5.5 Sensitivity to change in the timber harvesting land base 44
5.6 Sensitivity to an increased level of red alder management 45
5.7 Sensitivity to excluding low-site forest from the timber harvesting land base 47
5.8 Sensitivity to changes in yield estimates for existing stand 48
5.9 Sensitivity to changes in yield estimates for managed stand 49
5.10 Sensitivity to volume gains from the use genetically improved seed 50
5.11 Sensitivity to changes in minimum harvestable ages 51
5.12 Sensitivity to changes in productivity estimates for future stands 52
5.13 Sensitivity to the application of landscape-level biodiversity requirements 54
5.14 Sensitivity to proposed land-use decisions for the Central Coast Land and Resource Management Plan area 55
5.15 Summary of sensitivity analyses 58

6 SUMMARY AND CONCLUSIONS OF THE TIMBER SUPPLY ANALYSIS 59

Table of Contents

7 SOCIO-ECONOMIC ANALYSIS 60

7.1 CURRENT SOCIO-ECONOMIC SETTING 60
7.1.1 Current population and demographic trends 60
7.1.2 Economic profile 62
7.2 KINGCOME TSA FOREST INDUSTRY 65
7.2.1 Current allowable annual cut 65
7.2.2 Kingcome TSA harvest history 65
7.2.3 Kingcome TSA major licensees and processing facilities 67
7.2.4 Forestry sector employment and employment coefficients 72
7.2.5 Kingcome TSA employment income 74
7.2.6 Provincial government revenues 75
7.3 SOCIO-ECONOMIC IMPLICATIONS OF THE BASE CASE HARVEST FORECAST 76
7.3.1 Short- and long-term implications of alternative harvest levels 76
7.3.2 Community-level impacts 79
7.3.3 Nature, production capabilities and timber requirements of processing facilities 79
7.3.4 Regional timber supply issues 79
7.4 SUMMARY 80

8 REFERENCES 81

9 GLOSSARY 82

APPENDIX A DESCRIPTION OF DATA INPUTS AND ASSUMPTIONS FOR THE TIMBER SUPPLY ANALYSIS 89

INTRODUCTION 90

A.1 INVENTORY INFORMATION 91

A.2 ZONE AND ANALYSIS UNIT DEFINITIONS 93

A.3 DEFINITION OF THE TIMBER HARVESTING LAND BASE 95

A.4 FOREST MANAGEMENT ASSUMPTIONS 104

A.5 VOLUME ESTIMATES FOR EXISTING STANDS 111

A.6 VOLUME ESTIMATES FOR EXISTING REGENERATED STANDS 112

APPENDIX B SOCIO-ECONOMIC ANALYSIS BACKGROUND INFORMATION 113

B.1 LIMITATIONS OF ECONOMIC ANALYSIS 114

B.2 ECONOMIC IMPACT ANALYSIS METHODOLOGY 115

Table of Contents

Tables

TABLE 1. SPECIES AT RISK UNDER THE FOREST PRACTICES CODE (FEBRUARY 1999) 8

TABLE 2. DETERMINATION OF THE TIMBER HARVESTING LAND BASE FOR THE KINGCOME TSA 12

TABLE 3. SUMMARY OF BIOGEOCLIMATIC VARIANT AREAS — KINGCOME TSA, 2001. 19

TABLE 4. TREE IMPROVEMENT GAINS 51

TABLE 5. AVERAGE ANALYSIS UNIT SITE INDEX BASED ON FOREST INVENTORY AND ADJUSTED FOR OLD-GROWTH SITE INDEX INFORMATION — KINGCOME TSA, 2001 53

TABLE 6. SUMMARY OF THE CENTRAL COAST LAND AND RESOURCE MANAGEMENT PLAN — FRAMEWORK AGREEMENT AREA DELINEATED WITHIN THE KINGCOME TSA 56

TABLE 7. SUMMARY OF SENSITIVITY ANALYSIS — KINGCOME TSA, 2001 58

TABLE 8. PORT MCNEILL FOREST DISTRICT POPULATION STATISTICS, 1991–2005 61

TABLE 9. EMPLOYMENT MULTIPLIERS, BY SECTOR, FOR THE PORT MCNEILL FOREST DISTRICT, 1996 64

TABLE 10. KINGCOME TSA ALLOWABLE ANNUAL CUT, BY LICENCE TYPE 65

TABLE 11. KINGCOME TSA VOLUMES BILLED, BY LICENCE TYPE, 1993–2000 66

TABLE 12. INTERFOR VOLUMES BILLED AND PROVINCIAL EMPLOYMENT STATISTICS 67

TABLE 13. WESTERN VOLUMES BILLED AND PROVINCIAL EMPLOYMENT STATISTICS 68

TABLE 14. MILL AND TIMBER VOLUMES BILLED AND PROVINCIAL EMPLOYMENT STATISTICS 69

TABLE 15. WEYERHAEUSER VOLUMES BILLED AND PROVINCIAL EMPLOYMENT STATISTICS 70

TABLE 16. RICHMOND PLYWOOD VOLUMES BILLED AND PROVINCIAL EMPLOYMENT STATISTICS 71

TABLE 17. KINGCOME TSA EMPLOYMENT AND EMPLOYMENT COEFFICIENTS[8], AVERAGE 1998–2000 74

TABLE 18. AVERAGE DIRECT AND INDIRECT AND INDUCED INCOMES AND TOTAL EMPLOYMENT INCOME, 1998–2000 74

TABLE 19. AVERAGE ANNUAL PROVINCIAL GOVERNMENT REVENUES, 1998–2000 75

TABLE 20. KINGCOME TSA SOCIO-ECONOMIC IMPACTS: BASE CASE HARVEST FORECAST 78

TABLE A-1. INVENTORY INFORMATION 91

TABLE A-2. OBJECTIVES TO BE TRACKED 93

TABLE A-3. DEFINITION OF ANALYSIS UNITS 94

TABLE A-4. DESCRIPTION OF ENVIRONMENTALLY SENSITIVE AREAS 96

TABLE A-5. DESCRIPTION OF SITES WITH LOW TIMBER GROWING POTENTIAL 99

TABLE A-6. UNMERCHANTABLE FOREST TYPES CRITERIA 100

TABLE A-7. ESTIMATES FOR EXISTING AND FUTURE ROADS, TRAILS AND LANDINGS 101

TABLE A-8. REDUCTIONS TO REFLECT AREA RETENTION IN CUTBLOCKS FOR WILDLIFE TREE PATCHES 101

TABLE A-9. UTILIZATION LEVELS 104

TABLE A-10. VOLUME EXCLUSIONS FOR MIXED SPECIES TYPES 104

TABLE A-11. MINIMUM HARVESTABLE AGES 105

Table of Contents

Tables (continued)

TABLE A-12. UNSALVAGED LOSSES 106

TABLE A-13. REGENERATION ASSUMPTIONS BY ANALYSIS UNIT 107

TABLE A-14. IMMATURE PLANTATION HISTORY 108

TABLE A-15. TREE IMPROVEMENT GAINS 108

TABLE A-16. FOREST COVER REQUIREMENTS FOR CUTBLOCK ADJACENCY AND VISUAL VALUES 109

TABLE A-17. FOREST COVER REQUIREMENTS — BIOGEOCLIMATIC UNITS AND NATURAL DISTURBANCE TYPE (NDT) WITHIN THE KINGCOME TSA (APPLIED TO GROSS PRODUCTIVE FOREST) 110

TABLE A-18. TIMBER VOLUME TABLES FOR EXISTING NATURAL STANDS (CUBIC METRES) 111

TABLE A-19. TIMBER VOLUME TABLES FOR MANAGED STANDS (CUBIC METRES) 112

TABLE B-1. TOTAL EMPLOYMENT MULTIPLIERS 117

TABLE B-2. ESTIMATES OF PROVINCIAL GOVERNMENT REVENUE — KINGCOME TSA 118

Table of Contents

Figures

FIGURE 1. MAP OF THE KINGCOME TIMBER SUPPLY AREA, VANCOUVER FOREST REGION....6

FIGURE 2. COMPOSITION OF THE TOTAL LAND BASE AND PRODUCTIVE CROWN FOREST LAND BASE — KINGCOME TSA, 2001. 14

FIGURE 3. AREA BY DOMINANT SPECIES AND AGE CLASS — KINGCOME TSA TIMBER HARVESTING LAND BASE, 2001. 15

FIGURE 4. AREA BY DOMINANT SPECIES AND SITE CLASS — KINGCOME TSA TIMBER HARVESTING LAND BASE, 2001....16

FIGURE 5. CURRENT AGE CLASS COMPOSITION — KINGCOME TSA PRODUCTIVE FOREST LAND BASE, 2001. 17

FIGURE 6. FORESTED AREA BY BIOGEOCLIMATIC CLASSIFICATION — KINGCOME TSA, 2001. 18

FIGURE 7. MANAGEMENT ZONES — KINGCOME TSA FORESTED LAND BASE, 2001. 24

FIGURE 8. THE BASE CASE HARVEST — INITIAL HARVEST 5.7% BELOW THE CURRENT AAC — KINGCOME TSA, 2001....28

FIGURE 9. NATURAL, MANAGED AND MERCHANTABLE GROWING STOCKS — KINGCOME TSA TIMBER HARVESTING LAND BASE, 2001. 29

FIGURE 10. HARVEST CONTRIBUTION FROM NATURAL AND MANAGED STANDS — KINGCOME TSA, 2001. 30

FIGURE 11. AVERAGE AREA HARVESTED AND AVERAGE VOLUME PER HECTARE HARVESTED OVER TIME — KINGCOME TSA, BASE CASE HARVEST FORECAST 2001. 32

FIGURE 12. AVERAGE AGE OF HARVESTED STANDS OVER TIME — KINGCOME TSA BASE CASE HARVEST FORECAST, 2001. 33

FIGURE 13. CHANGES IN AGE COMPOSITION ON THE PRODUCTIVE CROWN FOREST OVER TIME — KINGCOME TSA BASE CASE HARVEST FORECAST, 2001. 34

FIGURE 14. ALTERNATE HARVEST FORECASTS INCLUDING NON-DECLINING HARVEST FLOW — KINGCOME TSA, 2001. 37

FIGURE 15. FORECASTS ASSUMING THE 33% AND 20% AREA IN EACH LANDSCAPE UNIT THAT CAN BE HARVESTED WITHIN A GREEN-UP PERIOD — KINGCOME TSA, 2001. 39

FIGURE 16. FORECASTS ASSUMING THE GREEN-UP AGES IN THE INTEGRATED RESOURCE MANAGEMENT AND ENHANCED FORESTRY ZONES ARE INCREASED AND DECREASED BY 5 YEARS — KINGCOME TSA, 2001. 40

FIGURE 17. FORECAST ASSUMING VISUAL QUALITY OBJECTIVES APPLIED TO ALL VISUALLY SENSITIVE AREAS IN THE VISUAL LANDSCAPE INVENTORY — KINGCOME TSA, 2001. 42

FIGURE 18. FORECASTS ASSUMING MAXIMUM DENUDATION FOR VISUAL QUALITY CLASSES SET TO THE HIGH- AND LOW-END OF THE RECOMMENDED RANGES — KINGCOME TSA, 2001. 43

FIGURE 19. LAND BASE SENSITIVITY ANALYSIS — KINGCOME TSA, 2001. 45

FIGURE 20. FORECAST ASSUMING 50% OF THE AREA OF RED ALDER HARVESTED IS REFORESTED TO RED ALDER-LEADING STANDS — KINGCOME TSA, 2001. 46

FIGURE 21. HARVEST FORECAST WHEN LOW PRODUCTIVITY CEDAR STANDS ARE EXCLUDED FROM THE TIMBER HARVESTING LAND BASE — KINGCOME TSA, 2001. 47

FIGURE 22. THE EFFECT ON THE HARVEST FORECAST OF INCREASING AND DECREASING EXISTING STAND YIELDS BY 10% — KINGCOME TSA, 2001. 48

FIGURE 23. EFFECT ON THE HARVEST FORECAST INCREASING AND DECREASING VOLUME ESTIMATES FOR MANAGED STANDS BY 10% — KINGCOME TSA, 2001. 49

FIGURE 24. HARVEST FORECAST BASED ON OGSI (VETERAN TREE STUDY) SITE INDEX ADJUSTMENTS — KINGCOME TSA, 2001. 53

FIGURE 25. HARVEST FORECAST WITH PPAS EXCLUDED FROM THE TIMBER HARVESTING LAND BASE AND VISUAL CONSTRAINTS APPLIED TO SPECIAL MANAGEMENT ZONES — KINGCOME TSA, 2001 57

FIGURE 26. PORT MCNEILL FOREST DISTRICT EXPERIENCED LABOUR FORCE BY SECTOR, 1996. 62

Introduction

Timber supply* is the quantity of timber available for harvest over time. Timber supply is dynamic, not only because trees naturally grow and die, but also because conditions that affect tree growth, and the social and economic factors that affect the availability of trees for harvest, change through time.

Assessing the timber supply involves considering physical, biological, social and economic factors for all forest resource values, not just for timber. Physical factors include the land features of the area under study as well as the physical characteristics of living organisms, especially trees. Biological factors include the growth and development of living organisms. Economic factors include the financial profitability of conducting forest operations, and the broader community and social aspects of managing the forest resource.

All of these factors are linked: the financial profitability of harvest operations depends upon the terrain, as well as the physical characteristics of the trees to be harvested. Determining the physical characteristics of trees in the future requires knowledge of their growth pattern. Decisions about whether a stand is available for harvest often depend on how its harvest could affect other forest values, such as wildlife or recreation.

These factors are also subject to both uncertainty and different points of view. Financial profitability may change as world timber markets change. Unforeseen losses due to fire or pest infestations will alter the amount and value of timber. The appropriate balance of timber and non-timber values in a forest is an ongoing subject of debate, and is complicated by changes in social objectives over time.

Thus, before an estimate of timber supply is interpreted, the set of physical, biological and socio-economic conditions on which it is based, and which define current forest management — as well as the uncertainties affecting these conditions — must first be understood.

Timber supply analysis is the process of assessing and predicting the current and future timber supply for a management unit (a geographic area). For a timber supply area (TSA)*, the timber supply analysis forms part of the information used by the chief forester of British Columbia in determining an allowable annual cut (AAC)*.

Timber supply projections made for TSAs look far into the future — 250 years or more. However, because of the uncertainty surrounding the information and because forest management objectives change through time, these projections should not be viewed as static prescriptions that remain in place for that length of time. They remain relevant only as long as the information upon which they are based remains relevant. Thus, it is important that re-analysis occurs regularly, using new information and knowledge to update the timber supply picture. Indeed, the *Forest Act* requires that the timber supply for management units throughout British Columbia be reviewed at least every 5 years. This allows close monitoring of the timber supply and of the implications for the AAC stemming from changes in management practices and objectives.

**Throughout this document, an asterisk after a word or phrase indicates that it is defined in a box at the foot of the page, as well as in the glossary.*

Timber supply
The amount of timber that is forecast to be available for harvesting over a specified time period, under a particular management regime.
Timber supply area (TSA)
An integrated resource management unit established in accordance with Section 7 *of the* Forest Act.

Allowable annual cut (AAC)
The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres of wood per year.

Introduction

Timber supply analysis involves three main steps. The first is collecting and preparing information and data. The B.C. Forest Service forest inventory* plays a major role in this. The second step is using this data along with a timber supply computer model or models* to make projections or estimates of possible harvest levels over time. These projections are made using different sets of assumed values or conditions for the factors discussed above. The third step is interpreting and reporting results.

Sections 1 through 7 of this report describe the timber supply analysis for the Kingcome TSA. Following a brief description of the area in Section 1, Section 2 addresses some important timber management issues in the Kingcome TSA and provides a discussion of data preparation and formulation of assumptions. Section 3 outlines the timber supply analysis methodology. Timber supply analysis results, including an assessment of the critical timber management issues, are presented in Section 4. Section 5 examines the sensitivity of the results to uncertainties in the data and assumptions used, and is followed by Section 6, summary and conclusions.

As part of the timber supply review, information is gathered on the short- and long-term implications of alternative harvest levels, and the capabilities and requirements of existing and proposed processing facilities. Section 7 of this report describes the socio-economic analysis, which provides the chief forester with some of the information necessary for these considerations. The socio-economic analysis also provides information for the local community to better understand the potential magnitude of impacts associated with any proposed harvest level changes.

Appendix A contains further details about the data and assumptions used in the timber supply analysis.

Appendix B contains background information and some of the limitations of the socio-economic data.

The socio-economic analysis considers the current and projected levels of forestry activity associated with the Kingcome TSA within the context of regional timber supplies and production capacity. It does this by examining the profile of the region and the local forest industry; and by assessing the employment and income implications of the timber harvesting levels as projected in the base case.

The analysis includes an estimate of the employment and income impacts associated with timber supply analysis projections by three main sectors: harvesting and woodlands-related activities, processing, and silviculture. Employment is measured in terms of person-years*. Employment income is calculated using average industry income estimates.

Forest inventory
An assessment of British Columbia's timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of other forest values such as recreation and visual quality.

Model
An abstraction and simplification of reality constructed to help understand an actual system or problem. Forest managers and planners have made extensive use of models, such as maps, classification systems and yield projections, to help direct management activities.

Person-year(s)
One person working the equivalent of one full year, defined as at least 180 days of work. Someone working full-time for 90 days accounts for 0.5 person-years.

Introduction

Data on direct employment, harvest levels, and fibre flows were obtained by surveying licensees and mill operators. The information was used to estimate harvesting, processing and silviculture direct employment averages associated with the harvest and the proportion of workers living in the area. The estimates of local and provincial harvesting, processing, and silviculture direct employment were then used to determine ratios of employment per 1000 cubic metres of timber harvested.

Indirect and induced employment were calculated using the Kingcome TSA and provincial employment multipliers* developed by the Ministry of Finance. Indirect impacts result from direct businesses purchasing goods and services; induced impacts result from direct employees purchasing goods and services. Employment coefficients* per 1000 cubic metres were also determined for these indirect and induced imports.

To estimate the level of employment that could be supported by alternative harvest rates, projected timber supply levels were multiplied by the calculated employment coefficients. It should be noted that employment coefficients are based on current productivity, harvest practices and management assumptions* and will not likely reflect industry conditions decades into the future. As such, the employment estimates should only be viewed in a general way.

Employment multiplier
An estimate of the total employment supported by each direct job, for example a multiplier of 2.0 means that one direct job supports one additional indirect and induced job.

Employment coefficient
The number of person-years of employment supported by every 1000 cubic metres of timber harvested; for example, a coefficient of 1.0 indicates that every 1000 cubic metres harvested supports one person-year, or 500 000 cubic metres supports 500 person-years.

Management assumptions
Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specification of minimum harvestable ages, utilization levels, integrated resource guidelines and silviculture and pest management programs.

1 Description of the Kingcome Timber Supply Area

The Kingcome Timber Supply Area (TSA) covers much of northern Vancouver Island, as well as the adjacent Queen Charlotte Straits and mainland area. However, most of the TSA is on the mainland, stretching from Knight Inlet in the south and east, to Cape Caution in the northwest and to Tweedsmuir Park in the northeast. Smaller portions of the TSA are located on the northern tip of Vancouver Island and adjacent to Brooks Bay on the west coast of Vancouver Island. The TSA, covering approximately 1.14 million hectares, is part of the Port McNeill Forest District, one of eight districts in the Vancouver Forest Region. The TSA is administered by the forest district office located in Port McNeill. The forest district also includes portions of a number of tree farm licences* (TFL 6, 37, 39, 43, 45 and 47).

In 2000, the population of the Port McNeill Forest District was approximately 14,495 people. More than half the population lives in the two largest communities of Port Hardy and Port McNeill. Port Alice and Alert Bay are the two other main communities; smaller communities include Coal Harbour, Holberg, Winter Harbour, Sointula and Woss. The population of the forest district declined slightly between 1996 and 2000, but is expected to increase through 2005.

The Kingcome TSA ranges from the poorly drained lowlands of northern Vancouver Island to the rugged Coast Mountains and the drier interior conditions of the upper Klinaklini watershed* on the mainland. The forests of the TSA are fairly diverse, but hemlock, amabilis fir and western redcedar are the predominant species. Smaller amounts of spruce, Douglas-fir, cypress and deciduous* species are also found. The TSA has a long history of harvesting activity, but the majority of harvesting has occurred in the last three decades. The result is a considerable area of younger forests on the more productive and accessible growing sites, and much of the remaining mature forest on poorer and less accessible sites.

The current allowable annual cut (AAC) in the Kingcome TSA is 1.399 million cubic metres. This level was set by the chief forester effective November 1, 1996, and represented a decrease of about 22% from the previous AAC. The coniferous* portion of the AAC was set at 1.244 million cubic metres (a 25% reduction). In addition, partitions* of 25 000 cubic metres for deciduous forest stands and 130 000 cubic metres for low-productivity stands were established.

About 51% of the TSA land base is considered productive forest land managed by the British Columbia Forest Service (approximately 586 000 hectares). Currently about 29% of this forested land base is considered available for harvesting (15% of the total TSA land base). Most of the area excluded from the harvesting land base is inoperable, or has low timber productivity and/or non-merchantable tree species.

Tree farm licence (TFL)
Provides rights to harvest timber, and outlines responsibilities for forest management, in a particular area.
Watershed
An area drained by a stream or river. A large watershed may contain several smaller watersheds.

Deciduous
Deciduous trees shed their leaves annually and commonly have broad-leaves.
Coniferous
Coniferous trees have needles or scale-like leaves and are usually 'evergreen'.
Partition
A portion of the AAC that is attributable to certain types of timber and/or terrain.

1 Description of the Kingcome Timber Supply Area

Significant changes that influence forest management have occurred since the last timber supply review was completed. These changes include:

- ongoing implementation of the *Forest Practices Code (FPC)** and improved understanding of its timber supply impacts;
- a review of sensitive soils using detailed terrain stability assessments and digital slope mapping;
- adjustments to operability* mapping for the TSA to better reflect recent harvesting performance and to incorporate stands of red alder and low-productivity cedar now considered to be commercially viable;
- establishment of draft landscape units (LU)*and biodiversity* objectives;
- a Vegetation Resources Inventory (VRI), completed for about 70% of the TSA;
- completion of a new Visual Landscape Inventory (VLI) for the TSA, and a revision to the amount of forest area that is subject to visual landscape management.

Forest Practices Code
Legislation, standards and guidebooks that govern forest practices and planning, with a focus on ensuring management for all forest values.
Operability
Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.

Landscape unit
A planning area based on topographic or geographic features, that is appropriately sized (up to 100 000 hectares), and designed for application of landscape-level biodiversity objectives.
Biodiversity (biological diversity)
The diversity of plants, animals and other living organisms in all their forms and levels of organization, including the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.

1 Description of the Kingcome Timber Supply Area

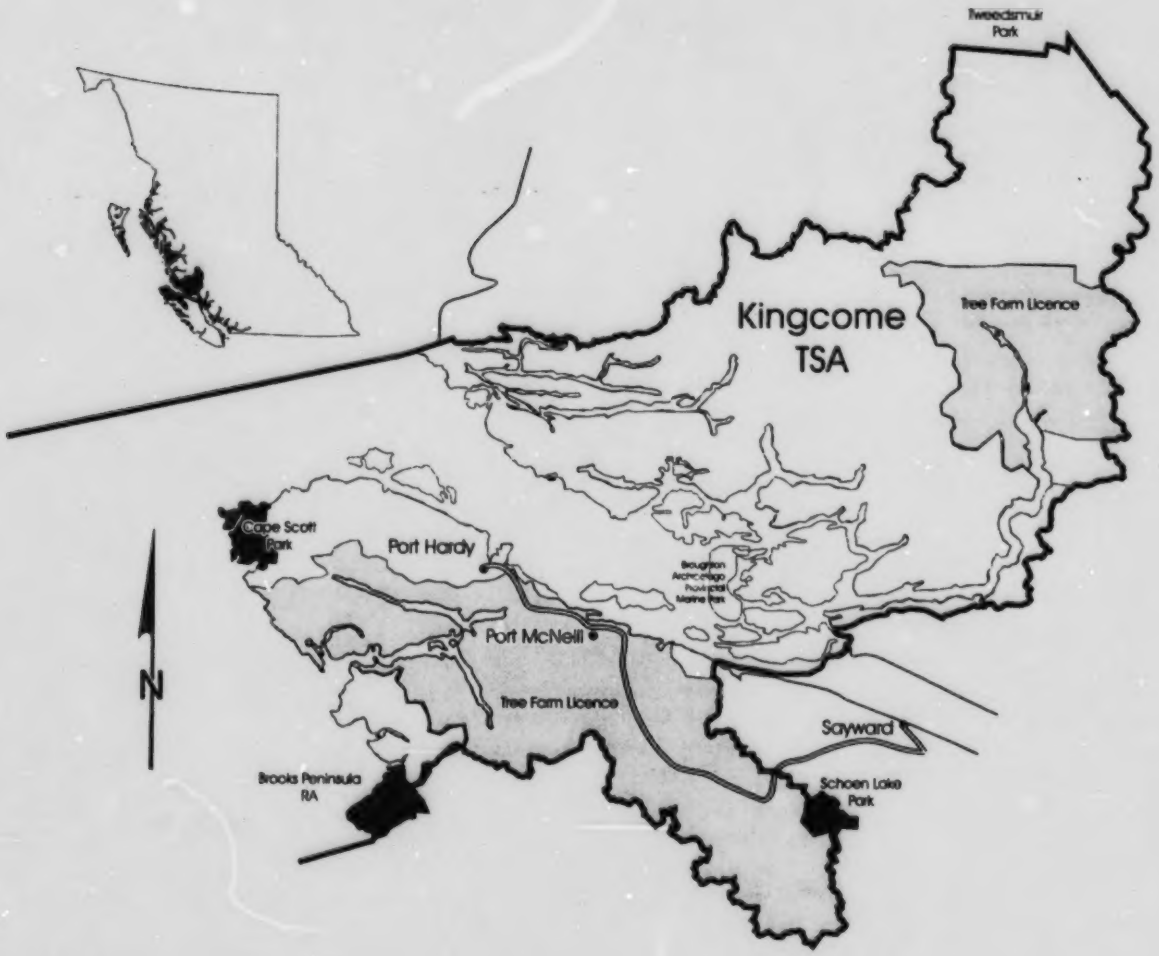

Figure 1. Map of the Kingcome Timber Supply Area, Vancouver Forest Region.

1 Description of the Kingcome Timber Supply Area

Two land-use planning processes will provide direction for resource management and for the establishment of new protected areas* in the Kingcome TSA. The first is the Vancouver Island Land Use Plan (VILUP), which covers the Vancouver Island portion of the TSA. New protected areas were announced in 1995; more recently, specific resource management objectives and strategies have been approved. Some of these, particularly those pertaining to special management zones and enhanced forestry zones, directly influence forest management and have been reflected in this timber supply analysis.

The second planning process is the Central Coast Land and Resource Management Plan (CCLRMP), which covers the mainland portion of the Kingcome TSA. Phase 1 of the plan was endorsed by the British Columbia government in April 2001 and included identifying numerous proposed protection areas, several which are located in the Kingcome TSA. Resource development continues to be deferred in these areas, pending their formal legal designation. In addition, two visual quality "special management zones" have been identified. An additional one to two years of planning is expected to be required to complete the CCLRMP. Approved land-use decisions from this planning process will be incorporated into future timber supply reviews.

The forests of the Kingcome TSA provide a wide range of forest land resources, including forest products (timber and non-timber), minerals, recreation and tourism amenities, community water supplies, and diverse fish and wildlife habitats. Tourism and recreational use within the TSA is largely marine-based, and has been increasing in recent years. Fishing, kayaking, whale watching, scuba diving and yachting are among the most popular activities. Numerous parks, recreation sites and trails, and roaded and non-roaded areas also provide opportunities for land-based activities, including hiking, camping, caving, freshwater fishing, mountaineering and wildlife viewing.

1.1 The environment

The five biogeoclimatic zones* that occur in the Kingcome TSA reflect the diversity of climates and vegetation in the area.

Most of the forested land in the Kingcome TSA is within the Coastal Western Hemlock (CWH) zone, the most productive forest ecosystem in Canada. This zone occurs at elevations from sea level to about 1000 metres and is the wettest zone in British Columbia, characterized by cool summers and mild winters. The dominant tree species is western hemlock, with Douglas-fir, western redcedar, Sitka spruce, yellow-cedar, amabilis fir, mountain hemlock, shore pine, maple and red alder also occurring, depending on local conditions and the history of the stand.

The other main forested zone is the Mountain Hemlock (MH) zone, which occurs at elevations above the CWH zone. The MH zone's subalpine climate is characterized by short, cool summers and long, cool and wet winters. The deep winter snowpack is slow to disappear, resulting in a short growing season. Mountain hemlock is the most prevalent tree species, with amabilis fir and yellow-cedar also being common. Other species are western hemlock, western redcedar, Douglas-fir and western white pine. Tree growth in this zone gradually diminishes with increasing elevation, until the tree canopy becomes interspersed with alpine tundra.

Two other forested zones, the Interior Douglas-fir zone and the Engelmann Spruce Subalpine Fir zone, have a very limited occurrence in the upper Klinaklini River watershed (just south of Tweedsmuir Park). This is an area of transition between coastal and interior ecosystems and, although not extensive, it does add to the ecological diversity of the Kingcome TSA.

Protected area
A designation for areas of land and water set aside to protect natural heritage, cultural heritage or recreational values (may include national park, provincial park, or ecological reserve designations).

Biogeoclimatic zones
A large geographic area with broadly homogeneous climate and similar dominant tree species.

1 Description of the Kingcome Timber Supply Area

The Alpine Tundra (AT) zone occurs at the highest elevations in the TSA. The climate is cold, windy and snowy with a short, cool growing season. Frost can occur at any time during the year. By definition this zone is treeless, although trees in stunted form are common at lower elevations. Vegetation is dominated by shrubs, herbs, mosses and lichens. Much of the alpine landscape lacks vegetation and is the domain of rock, ice and snow.

The forests of the Kingcome TSA are home to many species of wildlife. These include black-tailed deer, Roosevelt elk, moose, black bear, grizzly bear, mountain goat, wolf, cougar, marten and other fur-bearing species. Native and migratory birds in the area include marbled murrelets, northern goshawks, great blue herons and pileated woodpeckers. Adjacent marine habitats and estuaries support species such as Peale's peregrine falcons, bald eagles and trumpeter swans. Fish species found in the TSA include spring salmon, coho, pink salmon, chum salmon, steelhead, cutthroat and rainbow trout, and Dolly Varden char.

Under the *Forest Practices Code*, a process exists for identifying species at risk and designating wildlife habitat areas with specific management practices. The wildlife species that have been identified in *Volume 1* of the provincial *Identified Wildlife Management Strategy* in the seven ecosections found in the Port McNeill Forest District are presented in Table 1. The Northern Pacific Ranges and the Nahwitti Lowland are the main ecosections in the Kingcome TSA.

Table 1. Species at risk under the Forest Practices Code (February 1999)

Common names of identified wildlife	Ecosection						
	Hecate Lowland	Queen Charlotte Strait	Northern Pacific Ranges	Outer Fiordland	Nahwitti Lowland	Northern Island Mtns.	Windward Island Mtns.
Tailed frog	x		x	x			
Northern goshawk *laingi*		x			x	x	x
Northern goshawk *atricapillus*	x		x	x			
Sandhill crane					x		
Marbled murrelet	x	x	x	x	x	x	x
Cassin's auklet	x	x			x		x
Keen's long-eared myotis	x	x	x	x	X	x	x
Fisher			x				
Grizzly bear	x		x	x			
Mountain goat			x				

Source: Managing Identified Wildlife, Volume 1, February 1999.

Not all of the species in Table 1 have been confirmed as occurring in the Kingcome TSA portion of the ecosections listed. To date, no wildlife habitat areas (WHA) have been established in the TSA and therefore the timber supply analysis does not assume any specific timber supply impacts due to the Identified Wildlife Management Strategy (IWMS).

Current forest management practices follow the legislation and guidelines set out by the *Forest Practices Code*. Consequently, the protection of wildlife and the environment will be managed through the *Code*. In addition, the Vancouver Island Land Use Plan provides further management direction for public forest lands in the Kingcome TSA, as well as for wildlife species not included in the above list.

1.2 First Nations

Eleven First Nations bands have traditional territories within the Kingcome TSA. They are: Quatsino First Nation, Gwa'Sala-'Nakwaxda'xw First Nation, Kwakiutl First Nation, Da'Naxda'xw First Nation, Tlatlasikwala First Nation, Mamalillikulla-Qwe'Qwa'Sot'Enox First Nation, Tsawataineuk First Nation, Gwawaenuk Tribe, Kwicksutaineuk/ah'kwaha'mis First Nation, Namgis First Nation and Tlowitsis Tribe.

The total First Nations population is estimated at 4,200, of which about 1,900 people reside on reserves within the Port McNeill Forest District. Although the traditional territories of several bands are located on the mainland, the majority of First Nations people now reside in settlements on Vancouver Island or Cormorant Island, due to historic relocations. The main communities are located at Fort Rupert and on the Tsulquate reserve, both near Port Hardy; at the Quatsino reserve near Coal Harbour; and on the Namgis reserve on Cormorant Island, near Alert Bay. The Quaee reserve (commonly known as Kingcome Village) on the lower Kingcome River is the largest permanent settlement on the mainland; other smaller settlements are located on Gilford Island and Watson Island.

Some First Nations members are employed in the forest sector, as loggers, millworkers and silviculture workers. Commercial fishing is the other major source of employment. Some First Nations have expressed a strong interest in expanding their involvement in forestry-based activities, as well as expressing concern about the impacts of harvesting on fish, water and cultural resources.

The Kingcome TSA contains numerous known sites and areas of cultural significance for First Nations, including large numbers of culturally modified trees (CMT)*. An archaeological overview assessment (AOA), which identifies sites of potential cultural and heritage significance, has been developed for the TSA, as well as two traditional use studies. These studies are considered during the forest development planning process and additional detailed archaeological impact assessments (AIA) may be required on a site specific basis. Any available information regarding cultural or archaeological sites will be considered in this timber supply review.

Culturally modified tree
A tree or a remnant of a tree with evidence of traditional aboriginal forest use.

2 Information Preparation for the Timber Supply Analysis

Timber supply analysis requires three general categories of information: land base inventory; timber growth and yield; and management practices. These three categories are discussed below. Also, in preparation for the analysis, a number of changes since the 1995 Kingcome TSA timber supply analysis were noted, and are described in Section 2.4, "Changes since the 1995 Kingcome TSA analysis."

2.1 Land base inventory

Land base information used in this analysis was prepared in the form of a computer file compiled in 2001 by the B.C. Forest Service (BCFS). This file contains information on the forest land in the Kingcome TSA including general geographic location, area, nature of forest cover (such as presence or absence of trees, species, number of trees, age, and timber volume), and other characteristics such as environmental sensitivity and physical operability.

Forest inventory data for the Kingcome TSA was assembled from two sources. For Vancouver Island and the southern half of the mainland portion of the TSA the source was Vegetation Resource Inventory (VRI) cover maps completed in 1999. For the remainder of the TSA the source was forest cover inventory (FC1) maps created around 1974. Inventory maps from both sources have been updated to account for timber harvesting and other depletions to August 1999. Inventory updates for depletion were accomplished using a variety of data including aerial photos, satellite imagery and mapped harvest blocks from Forest Development Plans (FDP). Forest attributes such as tree height, stocking* and age have been projected for each stand to February 2001 in both the VRI and FC1 maps.

The inventory file represents the land base for the entire TSA. It includes information on land that does not contain forest, and other areas where timber harvesting is not expected to occur. Examples are land set aside for parks, areas needed to protect wildlife habitat, areas in utility and transportation corridors, and urban areas. A description of these areas specific to the Kingcome TSA is provided below. These types of areas do not contribute to the timber harvesting land base* of the Kingcome TSA. Before assessing timber supply, these non-contributing areas are identified and separated from the timber harvesting land base. When deriving this data file, care is taken to make only a single reduction for areas that overlap (for example, where an inoperable area is also an environmentally sensitive area*).

Identifying areas as not contributing to timber supply does not mean the area is removed from the Kingcome TSA. The B.C. Forest Service still manages the entire area of the TSA (except for designated areas under the jurisdiction of other agencies) as a land unit that contributes a mix of timber and non-timber values. The timber supply is managed within this integrated resource use context, and the analysis described here is consistent with this philosophy.

This section describes the types of areas not contributing to the timber harvesting land base. Use of the term timber harvesting land base in this report does not mean the area is open to unrestricted logging. Rather, it implies that forests in the area contain accessible timber of sufficient economic value — and sites of adequate environmental resilience — to accommodate timber harvesting with due care for other resources.

For the Kingcome TSA, the following types of areas were excluded from the timber harvesting land base:

- not managed by the B.C. Forest Service — these are non-Crown areas (such as private land and Indian Reserves) and parks which are removed from the productive forest. The forested portions of parks and ecological reserves contribute towards biodiversity management objectives.
- non-forested and non-productive forested areas — areas not occupied by productive forest cover (e.g., rock, swamp, alpine areas and water bodies).

Stocking
The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.

Timber harvesting land base
Crown forest land within the timber supply area where timber harvesting is considered both acceptable and economically feasible, given objectives for all relevant forest values, existing timber quality, market values and applicable technology.

Environmentally sensitive areas
Areas with significant non-timber values, fragile or unstable soils, impediments to establishing a new tree crop, or high risk of avalanches.

- non-commercial cover areas — areas occupied by non-commercial tree or brush species.
- environmentally sensitive areas (ESAs) — areas with sensitive soils, high wildlife values, recreation values, avalanche hazards, and tree regeneration problems.
- unstable terrain areas — areas with a moderate or high likelihood of landslide initiation following timber harvesting or road construction.
- inoperable areas*— areas classified as unavailable for harvest due to a combination of accessibility, economic and terrain-related reasons.
- the Klinaklini Supply Block — a large area in the north-east portion of the TSA considered unavailable for timber harvesting at the present time due to its current inaccessibility and prohibitively high road construction costs.
- sites with low timber productivity — areas occupied by forest with low timber-growing potential.
- non-merchantable forest types*— stands which are physically operable and exceed low site criteria yet are not currently utilized or have marginal merchantability, including most pine-leading stands and some deciduous species.
- existing roads, trails and landings (RTL) — areas of forest land that have been removed from timber production due to access development and harvesting to date.
- riparian reserve, riparian management and gully management areas — areas assumed to be unavailable for harvesting to provide protection for riparian and stream ecosystems.
- wildlife tree* patches (WTP) — areas reserved within and along the edges of cutblocks* for the maintenance of stand-level biodiversity* (stand structure), primarily for conservation or enhancement of wildlife.
- future roads, trails and landings — future losses of productive forest land to access development. These areas will be removed from the timber harvesting land base as part of the first harvest.

A more detailed description of these categories, including specific criteria for removal is located in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." Table 2 summarizes the areas in each category, and shows the area of the timber harvesting land base.

The current timber harvesting land base in the Kingcome TSA, which is the area estimated to be available for timber harvesting, is 168 726 hectares. This represents about 15% of the total TSA area and about 29% of the productive forest. Most of the excluded area is in three categories: inoperable areas (40.3% of the productive forest), low timber productivity / non-merchantable species (18.7%) and environmentally sensitive areas (6.3%). The remaining categories, such as riparian areas*, represent 6.0% of the productive forest. The percentages provided depend on the order in which each category is considered. For instance, riparian areas would constitute a larger proportion of the reduction if they were considered prior to inoperable areas. A summary of the land base classes in the productive forest land base and timber harvesting land base is provided in Table 2.

Inoperable areas
Areas defined as unavailable for harvest for terrain-related or economic reasons. Characteristics used in defining inoperability include slope, topography (e.g., the presence of gullies or exposed rock), difficulty of road access, soil stability, elevation and timber quality. Operability can change over time as a function of changing harvesting technology and economics.

Non-merchantable forest types
Stands that are accessible and otherwise available for harvesting but are assumed to be non-merchantable due to stand characteristics such as small piece size, incidence of decay, species composition and low stocking.

Wildlife tree
A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.

Cutblock
A specific area, with defined boundaries, authorized for harvest.

Stand-level biodiversity
A stand is a relatively localized and homogeneous land unit that can be managed using a single set of treatments. In stands, objectives for biodiversity are met by maintaining specified stand structure (wildlife trees or patches), vegetation species composition and coarse woody debris levels.

Riparian area
Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.

2 Information Preparation for the Timber Supply Analysis

Table 2. Determination of the timber harvesting land base for the Kingcome TSA

Classification	Area (hectares)	Per cent (%) of total TSA area	Per cent (%) of Crown forest area
Total TSA area	1 139 187	100.0	
Not managed by B.C. Forest Service	29 179	2.6	
Non-forest	398 152	35.0	
Non-productive	125 510	11.0	
Productive forest[a]	586 345	51.5	100.0
Inoperable	236 104	20.7	40.3
Low site	102 408	9.0	17.5
Non-merchantable types managed	6 910	0.6	1.2
Environmentally sensitive areas (ESA)	36 825	3.2	6.3
Unstable terrain	8 691	0.8	1.5
Riparian	17 293	1.5	2.9
Wildlife tree retention	2 923	0.3	0.5
Roads	6 465	0.6	1.1
Total reductions	417 620	36.7	71.2
Current timber harvesting land base[b,c]	168 726	14.8	28.8
Reduction for future roads	4 612	0.4	0.8
Long-term timber harvesting land base	164 114	14.4	28.0

(a) The total Crown forested land base in the Kingcome analysis area, which includes some protected areas not managed by the B.C. Forest Service, is approximately 609 629 hectares. Although protected areas are not managed for timber supply, the forested areas within them contribute to non-timber objectives such as requirements for old-seral forest to maintain landscape-level biodiversity.

(b) Timber harvesting land base includes 6205 hectares of unreverted timber licence which do not contribute to the TSA timber supply until after they are harvested and regenerated.

(c) Timber harvesting land base includes 5543 hectares of regenerating forest which are assumed in the analysis to be stocked in 1 to 4 years from now.

2 Information Preparation for the Timber Supply Analysis

The total Crown forested land base in the Kingcome analysis area, which includes some protected areas not managed by the B.C. Forest Service, is approximately 609 629 hectares. Although protected areas are not managed for timber supply, the forested areas within them contribute to non-timber objectives such as requirements for old-seral forest to maintain landscape-level biodiversity*.

Most wildlife tree patches in the Kingcome TSA are greater than two hectares in size. Therefore, the area excluded from the timber harvesting land base for wildlife tree patches may contribute to landscape-level biodiversity requirements.

Timber harvesting land base includes 6205 hectares of unreverted Timber Licence which do not contribute to the TSA timber supply until after they are harvested and regenerated.

The timber harvesting land base includes 5543 hectares of regenerating forest which are assumed in the analysis to be stocked in 1 to 4 years from now.

The long-term timber harvesting land base is 164 114 hectares is about 4% smaller than in the 1995 timber supply analysis for the Kingcome TSA. This is because more area is excluded as inoperable, low-productivity forest or environmentally sensitive areas. As well, reductions for riparian areas and wildlife tree patches are larger. These increased reductions were offset somewhat by the addition of several large areas transferred from neighbouring tree farm licences in the Port McNeill Forest District.

Landscape-level biodiversity
The Landscape Unit Planning Guide *provides objectives for maintaining biodiversity at both the landscape level and the stand level. At the landscape level, guidelines are provided for the maintenance of seral stage distribution, patch size distribution and landscape connectivity.*

2 Information Preparation for the Timber Supply Analysis

Figure 2 represents both the total Kingcome TSA area, and the productive forest land base. The total area chart shows that about 2.6% of the total land base is classified as not managed by the B.C. Forest Service (B.C.F.S.), 35.0% is classified as non-forest and 11.0% is classified as non-productive forest (i.e., having very few trees). The 586 345 hectares of productive forest in the TSA managed by the B.C.F.S. is also broken down into various land classes. Figure 2 shows that almost 28.8% of the productive Crown forest in the Kingcome TSA is considered to be available for timber harvesting, including regenerating stands and timber licences (TL).

The total productive Crown forest area considered in the analysis is 609 629 hectares. This includes 18 184 hectares of forested park area outside of the Kingcome TSA which is important for landscape-level biodiversity.

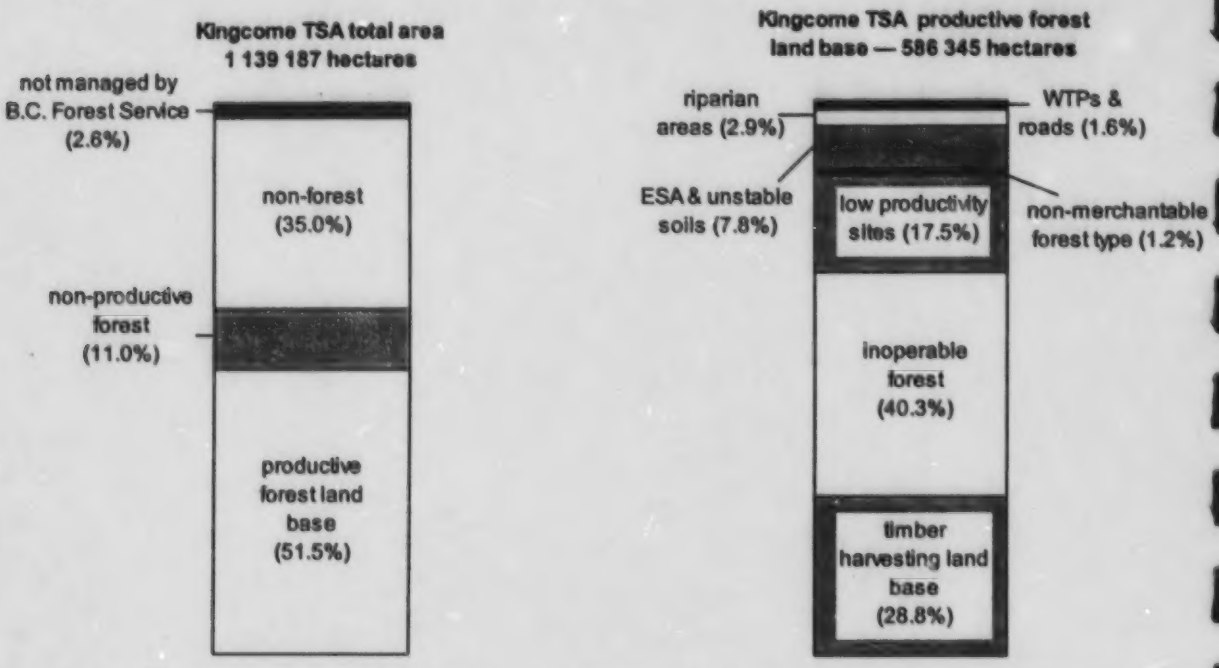
Kingcome TSA total area
1 139 187 hectares
not managed by B.C. Forest Service (2.6%)
non-forest (35.0%)
non-productive forest (11.0%)
productive forest land base (51.5%)
Kingcome TSA productive forest land base — 586 345 hectares
riparian areas (2.9%)
WTPs & roads (1.6%)
ESA & unstable soils (7.8%)
low productivity sites (17.5%)
non-merchantable forest type (1.2%)
inoperable forest (40.3%)
timber harvesting land base (28.8%)

Figure 2. Composition of the total land base and productive Crown forest land base — Kingcome TSA, 2001.

Figure 3 shows the current composition of the timber harvesting land base by dominant tree species groups. Hemlock- and balsam-leading stands comprise 51.3% of the timber harvesting land base. Redcedar- and cypress-leading stands occupy 43.8% of the timber harvesting land base. Spruce and Douglas-fir-leading stands cover 4.2% of the timber harvesting land base. A small area of the timber harvesting land base (0.7%) is occupied by red alder stands. After harvest, most stands are expected to be regenerated to stands as described in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis."

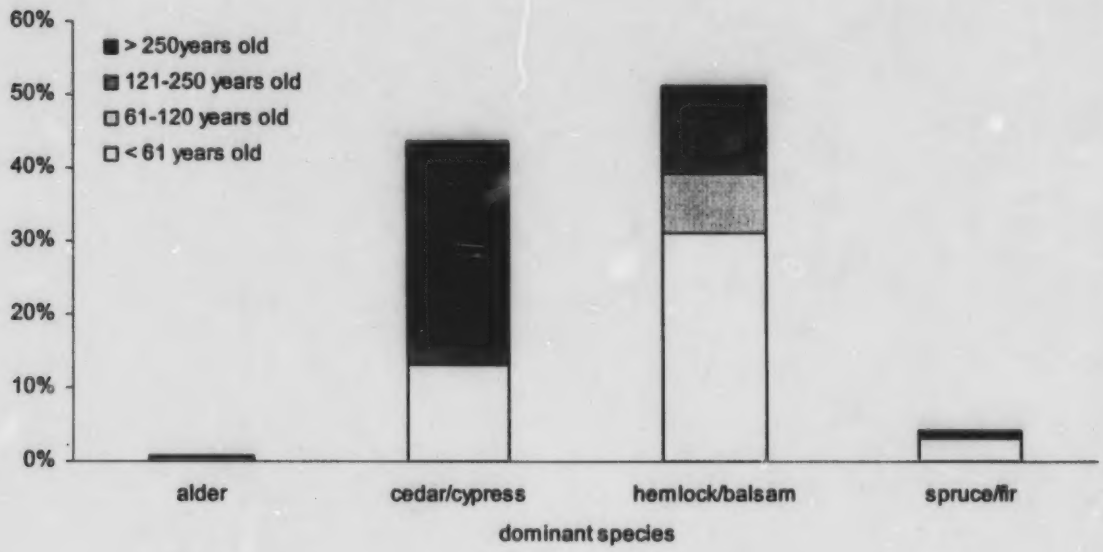

Figure 3. Area by dominant species and age class — Kingcome TSA timber harvesting land base, 2001.

Figure 3 also shows the proportion of area of each species among four broad age groups. In total, about 32.6% of stands in the timber harvesting land base are over 250 years old, most of which are cedar- and cypress-leading stands. Approximately 43% of the timber harvesting land base is over 120 years old. Stands under 61 years old comprise 48.3% of the timber harvesting land base, the majority of which are hemlock- and balsam-leading.

2 Information Preparation for the Timber Supply Analysis

Figure 4 provides an overview of the distribution of site productivity of the dominant stand types within the timber harvesting land base. The site classes in Figure 4 are groupings of site index (SI)* (metres in height at age 50 years) based on the analysis unit (AU)* definitions described in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis."

About 34% of the stands are in the 'poor' site class, while stands with a site class of 'medium' occupy 40% of the area, and those with a site class of 'good', cover 26% of the timber harvesting land base. As described above in Section 2.1, "Land base inventory," sites with 'very poor' productivity are excluded from the timber harvesting land base.

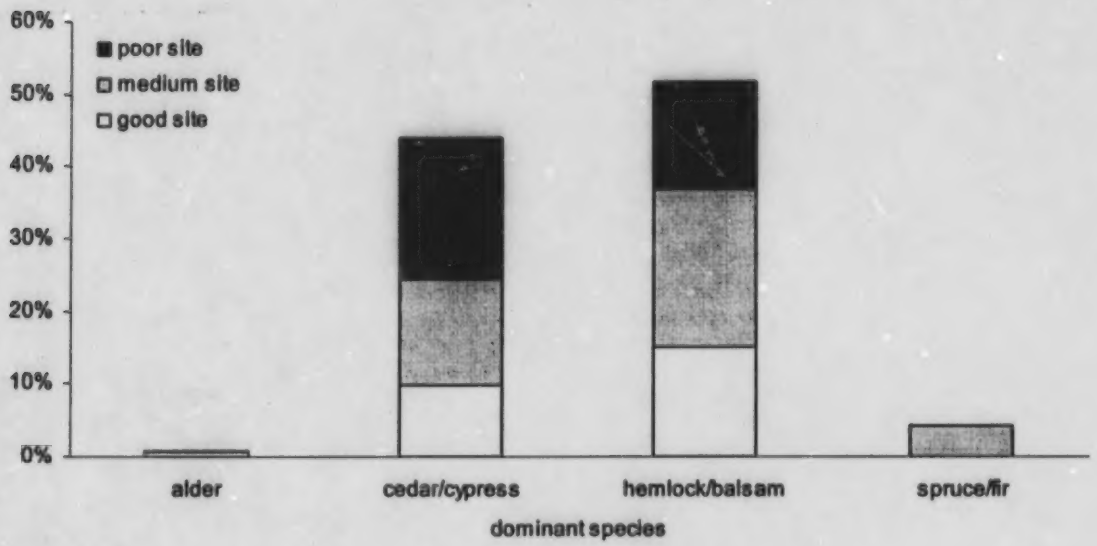

Figure 4. Area by dominant species and site class — Kingcome TSA timber harvesting land base, 2001.

Site index
A measure of site productivity. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground). Site index curves have been developed for British Columbia's major commercial tree species.

Analysis unit
A grouping of types of forest — for example, by species, site productivity, silvicultural treatment, age, and or location — done to simplify analysis and generation of timber yield tables.

2 Information Preparation for the Timber Supply Analysis

Figure 5 shows the current age composition of forested stands in the Kingcome TSA. About 31% of the timber harvesting land base is occupied by stands older than 250 years. About 34% of the area is covered with stands 20 years or younger, 25% is between 21 and 100 years old, and 10% is between 101 and 250 years of age.

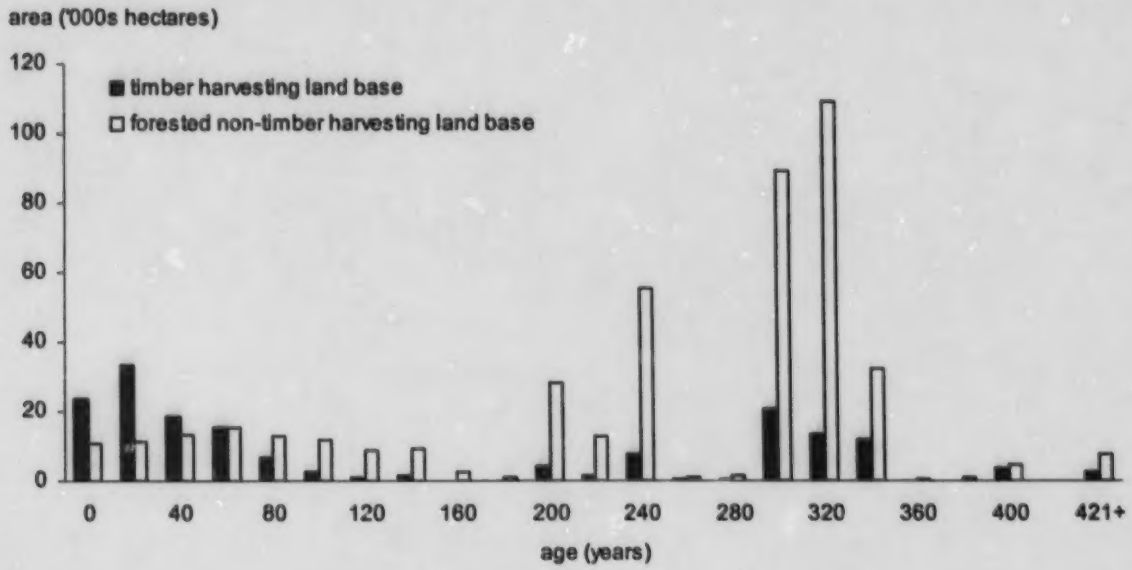

Figure 5. Current age class composition — Kingcome TSA productive forest land base, 2001.

Most of the forest outside the timber harvesting land base is old. Although not directly contributing to timber supply, these areas can affect the timber supply forecast by providing for non-timber values such as wildlife habitat, biodiversity and wilderness recreation, and by reducing the extent to which these values must be achieved on the timber harvesting land base.

The productive Crown forest land base defined for this analysis is 609 629 hectares. This comprises all productive forest on Crown land in the TSA including 22 320 hectares of productive forest not managed by the B.C. Forest Service, and including parks outside the TSA but in landscape units common with the TSA. A significant portion of the productive Crown forest area — 71.2% — does not contribute to the timber harvesting land base. This area is referred to in Figure 5 as the 'non-timber harvesting land base'. Over 56% of the non-timber harvesting land base is currently over the age at which stands are considered old (250 years). Approximately 27% of the non-timber harvesting land base is between 101 and 250 years old and 17% is younger than 101 years old. The distribution of the non-timber harvesting land base under 141 years old is more uniform with approximately 10 000 hectares in each 20 year class interval. The large variation in area in the non-timber harvesting land base between 290 and 350 years old is likely because the interpretation of stand age is less precise in very old forests. The distribution of area between these age groups may be more uniform than shown.

The large proportion of old-forest that is also non-timber harvesting land base will provide much of the area needed to meet old-forest biodiversity requirements set out in the *Landscape Unit Planning Guide (LUPG)* for many landscape units in the TSA.

2 Information Preparation for the Timber Supply Analysis

Figure 6 shows the distribution of the land base by biogeoclimatic (BEC) variant. Also shown is the proportion of the total forest area in each BEC variant that is part of the timber harvesting land base. Table 3 provides a summary of the proportion of the timber harvesting land base and non-timber harvesting land base in each BEC variant. The proportion of non-timber harvesting land base is important because it provides some indication of the likelihood that forest outside the timber harvesting land base will be sufficient to meet old-forest requirements.

Over 90% of the productive Crown land base is within the Coastal Western Hemlock (CWH) zone, and 57% is in either the sub-montane (CWH vm1) or montane variants (CWH vm2) and about 32% is in the very-wet hypermaritime (CWH vh1) variant. Table 3 shows that for the three predominant variants of the productive Crown land base, approximately 73% of CWHvh1, 58% of CWHvm1 and 91% of CWHvm2 areas are in the non-timber harvesting land base. Most of the area within other BEC variants is in the non-timber harvesting land base as well. Overall the figures suggest that forest in the non-timber harvesting land base is sufficient to meet old-forest requirements.

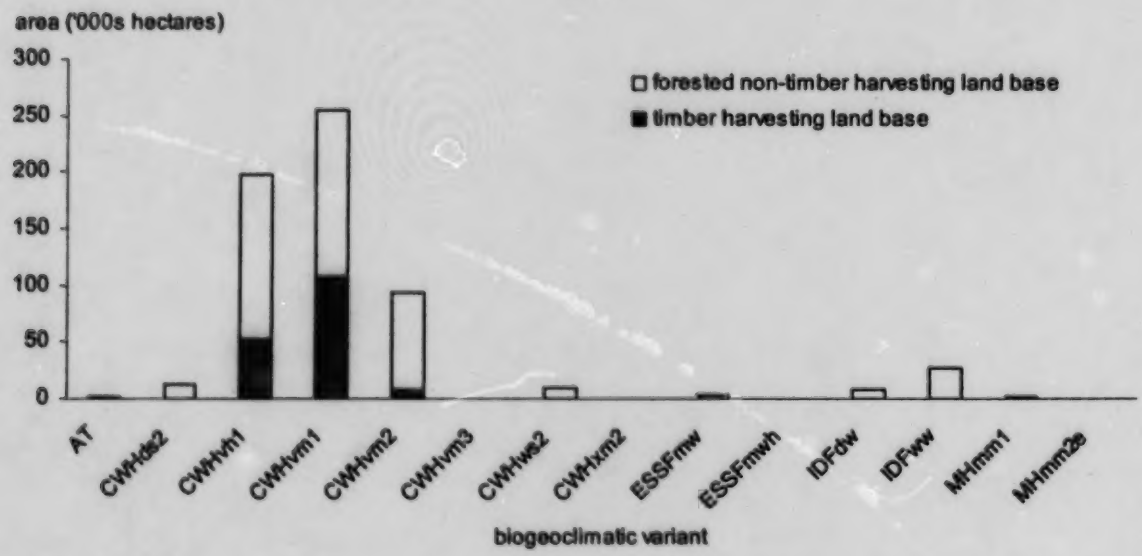

Figure 6. Forested area by biogeoclimatic classification — Kingcome TSA, 2001.

Table 3. Summary of biogeoclimatic variant areas — Kingcome TSA, 2001.

Biogeoclimatic ecosystem classification (BEC) variant	Total forested are in BEC variant (hectares)	Per cent (%) of the total forested area in BEC variant	Per cent (%) of the timber harvesting land base in BEC variant	Per cent (%) of BEC variant contributing to the timber harvesting land base
AT	1 871	0.31	0.41	3
CWHds2	13 092	2.15	2.97	0
CWHvh1	198 020	32.48	33.00	27
CWHvm1	254 766	41.79	33.36	42
CWHvm2	92 510	15.18	19.18	9
CWHvm3	106	0.02	0.02	0
CWHws2	9 134	1.50	2.07	0
CWHxm2	113	0.02	0.00	86
ESSFmw	2 622	0.43	0.59	0
ESSFmwh	776	0.13	0.18	0
IDFdw	8 242	1.35	1.87	0
IDFww	26 728	4.38	5.97	2
MHmm1	1 572	0.26	0.36	0
MHmm2e	64	0.01	0.01	0

2.2 Timber growth and yield

Two growth and yield models were used to estimate timber volumes for this analysis. The variable density yield prediction (VDYP)* model, developed by the Ministry of Sustainable Resource Management, Terristrial Inventory Branch, was used for estimating volumes in unmanaged/natural coniferous and deciduous stands as well as managed deciduous stands. The table interpolation program for stand yields (TIPSY)*, developed by the B.C. Forest Service, Research Branch, was used to estimate yields for managed coniferous stands. Managed stands include those that were harvested in the past but managed to current standards, which may be as old as 30 years of age in the Kingcome TSA, depending on species.

Variable Density Yield Prediction model
An empirical yield prediction system supported by the B.C. Forest Service, designed to predict average yields and provide forest inventory updates over large areas (i.e., Timber Supply Areas). It is intended for use in unmanaged natural stands of pure or mixed composition.

Table Interpolation Program for Stand Yields
A B.C. Forest Service computer program used to generate yield projections for managed stands based on interpolating from yield tables of a model (TASS) that simulates the growth of individual trees based on internal growth processes, crown competition, environmental factors and silvicultural practices.

2 Information Preparation for the Timber Supply Analysis

Timber volumes are estimated based on assumptions including a specific utilization level, or set of dimensions, which establish the minimum tree and log sizes that are removed from a site. Utilization levels used in estimating timber volumes specify minimum diameters both near the base and the top of a tree as well as a maximum stump height. Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis" contains details on the definition of managed stands, utilization standards and the specific model versions used. Volume estimation and prediction are subject to uncertainty due to uncertainties in inventories which form the basis for estimating site productivity, limited experience with second-growth in British Columbia, and the long-time frame over which trees grow.

In 1996 a Phase 1 — Vegetation Resources Inventory (VRI) was initiated for the Kingcome TSA. Phase 1 — VRI involves photo interpretation, classification and mapping of vegetation types. Photo interpretation and mapping has been completed for the southern half of the TSA (mapsheets 102I, 92L, 92K and 92N except the Klinaklini supply block); approximately 75% of the timber harvesting land base. For the remainder of the TSA not covered by the VRI, older Forest Inventory Program (FIP) data were used in the analysis.

Vegetation Resource Inventory photo-interpreted information is current to the date of the photography used, which was taken between 1996 and 1997. The FIP data were originally collected around 1970 but updated to 1993. For this timber supply analysis, VRI and FIP data were updated to reflect harvest activity that has occurred up to August 1999. This was accomplished using a variety of data sources including cutblock maps produced from satellite imagery, information summarized from the Integrated Silviculture Information System (ISIS), Major Licensee Silviculture Information System (MLSIS) records and cutblock boundaries obtained from forest licensees.

Volume estimates (yield projections)
Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products, and for empirical (average stocking), normal (optimal stocking) or managed stands.

The accuracy of volume estimates* in the FIP data were evaluated in an inventory audit completed in 1995. The results of this audit indicated that the inventory, assessed for the entire TSA, overestimated stand volumes by an average of 11% across all forested Crown land and 18% across the operable land base. The usefulness of the 1995 audit sampling for assessing the accuracy of the northern portion of the old inventory is limited by the small number of samples that were collected in that area.

The current timber inventory on the timber harvesting land base is approximately 56 million cubic metres. About 50 million cubic metres, or 89%, of the volume on the timber harvesting land base are currently older than the minimum harvestable age (MHA) (see Figure 9).

2.3 Management practices

Timber supply depends directly on how the forest is managed for both timber and non-timber values. Therefore, levels of management activity must be defined for the timber supply analysis. The *Forest Practices Code of British Columbia Act* and associated regulations guide forest management practices in the Kingcome TSA. The focus of the timber supply review is to assess timber supply based on current management practices as implemented in plans for the area. Current management is described in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." Staff in the Port McNeill Forest District provided information for the following management practices:

- Protection of environmentally sensitive areas — areas where hazardous terrain, sensitive soils, avalanche hazards, regeneration problems and high values for recreation, wildlife, and watersheds have been identified. To maintain ecological or other resource values, portions or all of these areas have been excluded from the timber harvesting land base, as detailed in Appendix A, Section 3.4, "Environmentally sensitive areas."

- Silviculture — even-aged management under a clearcut with reserves silviculture system is assumed to be current practice. Prompt reforestation with acceptable tree species is assumed to occur between 2 and 4 years following harvesting.
- Incremental silviculture — where necessary, stands are spaced early in their development to ensure young trees are well distributed to maximize growth. Improved seed from seed orchards is used when possible.
- Forest health and unsalvaged losses* — unharvestable timber losses to fire, wind, insect and other sources are expected to average 13 583 cubic metres per year.
- Utilization levels — the minimum size of tree expected to be utilized is defined by a top diameter inside bark (dib) of 10 centimetres and a minimum diameter at breast height (dbh) of 17.5 centimetres for natural stand and 12.5 centimetres for managed stands.
- Minimum harvestable ages (MHA) — the time it takes for stands to grow to a merchantable condition. These were set to the greater of: a) the estimated age at which the stand is predicted to reach a required volume; and b) the age at which the stand's mean annual increment (MAI)*achieves a value of 95% of the maximum (culmination). Actual harvest ages may be greater but not less than the minimum, and will depend on ages of other available stands, forest cover objectives* and overall timber harvest targets.
- Cutblock adjacency* and green-up*— in the Kingcome TSA, approval of harvesting activities is contingent on previously harvested stands reaching a desired condition, or green-up, before adjacent stands may be harvested. This green-up condition is 3 metres in height for integrated resource management (IRM)*areas and 5 metres in height for visual quality management areas. The purpose of the cutblock adjacency guidelines is to prevent timber harvesting from becoming overly concentrated in an area at any one time. In the integrated resource management (IRM) zone, these guidelines were modelled by limiting the IRM zone area within each landscape unit that does not meet green-up conditions to a maximum of 25%.

Unsalvaged losses
The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) that is not harvested.
Mean annual increment (MAI)
Stand volume divided by stand age. The age at which average stand growth, or MAI, reaches its maximum is called the culmination age (CMAI). Harvesting all stands at this age results in a maximum average harvest over the long term.
Forest cover objectives
Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives (see ***Cutblock adjacency*** *and* ***Green-up****).*

Cutblock adjacency
The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested areas must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested. Specifications for the maximum allowable proportion of a forested landscape that does not meet green-up requirements are used to approximate the timber supply impacts of adjacency restrictions.
Green-up
The time needed after harvesting for a stand of trees to reach a desired condition (usually a specific height) — to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics — before harvesting is permitted in adjacent areas.
Integrated resource management (IRM)
The identification and consideration of all resource values, including social, economic and environmental needs, in resource planning and decision-making.

- Scenic values — areas in which scenic values are to be maintained when carrying out forest development have been made 'known' under the *Forest Practices Code*. Although visual quality objectives* have yet to be formally established, current practice has been to apply the recommended visual quality class (RVQC) when harvesting in these areas. Management for scenic areas* has been modelled by limiting the proportion of young forest, less than 5 metres tall, that may be present in each scenic area. This maximum area of alteration is dependent on the forest characteristics and RVQC of the visual areas.
- Community watersheds (CWS) — management in community watersheds was accounted for by limiting harvesting in each watershed to a maximum of 1% of the forested area per year. Designated community watersheds cover less than 1% of the timber harvesting land base.
- Vancouver Island Land Use Plan (VILUP) — under VILUP several resource management zones, including Special Management Zones (SMZs) and Enhanced Forestry Zones (EFZ) were established in the Kingcome TSA. Forest practices in SMZs are generally more constrained than in other areas. In the case of SMZs in the Kingcome TSA, constraints are related primarily to visual management, linked to recreational and tourism activities and require that a minimum area of mature forest be retained in the SMZ areas. In EFZ harvest constraints associated with cutblock adjacency are relaxed somewhat by specifying a green-up height of 1.5 metres.
- Landscape-level biodiversity — to maintain biological diversity throughout a landscape unit, the *Forest Practices Code* contains targets for the proportion of the area in each biogeoclimatic variant* that should be covered by stands with old-forest characteristics. In the Kingcome TSA, stands older than 250 years are considered old forest. Since landscape unit objectives and biodiversity emphasis options (BEO) have not been established for each landscape unit, a weighted-average old-forest requirement was applied to all draft landscape units. See Section A.4.4, "Forest cover requirements" in Appendix A for details.
- Stand-level biodiversity — to maintain biological diversity in forest stands, wildlife tree patches are retained after harvesting. In the Kingcome TSA, retention of wildlife tree patches has been modelled by reducing the size of the timber harvesting land base, as described above in Section 2.1, "Land base inventory." Further details on how stand-level biodiversity was accounted for in the analysis are described in Appendix A, Section 3.10, "Wildlife tree retention."

Visual quality objective (VQO)
Defines a level of acceptable landscape alteration resulting from timber harvesting and other activities. A number of visual quality classes have been defined on the basis of the maximum amount of alteration permitted.
Scenic area
Any visually sensitive area or scenic landscape identified through a visual landscape inventory or planning process carried out or approved by a district manager.

Biogeoclimatic (BEC) variant
A subdivision of a biogeoclimatic subzone. Variants reflect further differences in regional climate and are generally recognized for areas slightly drier, wetter, snowier, warmer or colder than other areas in the subzone.

- Timber licence reversions — Timber Licences provide the holder rights to harvest mature timber from the licence area. These areas revert to the TSA when they have been harvested and satisfactorily restocked by the licensee. Timber licences were included in the timber harvesting land base, but were only allowed to contribute to timber supply following their harvest and regeneration.
- Natural disturbances — natural disturbances of fire and wind do occur within the forests of the Kingcome TSA, causing some old-seral forests to revert to a younger seral stage* after disturbance. In an effort to emulate the effect that natural disturbances have on projected harvest forecasts*, the model reverts 500 hectares per year of non-contributing old forests to regenerated forests.

The data package for the Kingcome Timber Supply Area (TSA) was released in June 2000. As a result of public input, changes were required to the data package. The revised data package, which includes detailed descriptions of the management practices and the assumptions used to incorporate them into the analysis, is presented in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis" of this document.

Seral stages
Sequential stages in the development of plant communities that successively occupy a site and replace each other over time.

Harvest forecast
The flow of potential timber harvests over time. A harvest forecast is usually a measure of the maximum timber supply that can be realized over time for a specified land base and set of management practices. It is a result of forest planning models and is affected by the size and productivity of the land base, the current growing stock, and management objectives, constraints and assumptions.

Figure 7 shows the proportions of the forested land base and the timber harvesting land base subject to management for scenic values, designated community watersheds, and cutblock adjacency constraints in the integrated resource management (IRM) zone, scenic areas (VQO-M is modification, PR is partial retention, R is retention, P is preservation), community watersheds (CWS) and Vancouver Island Land Use Plan (VILUP) management zones. Often several management objectives are applied to the same area; for example, all or part of a visual quality area may also be managed as a community watershed. In such a case, the area is required to meet all of the management objectives. The bar charts show the total forested area in each management emphasis area.

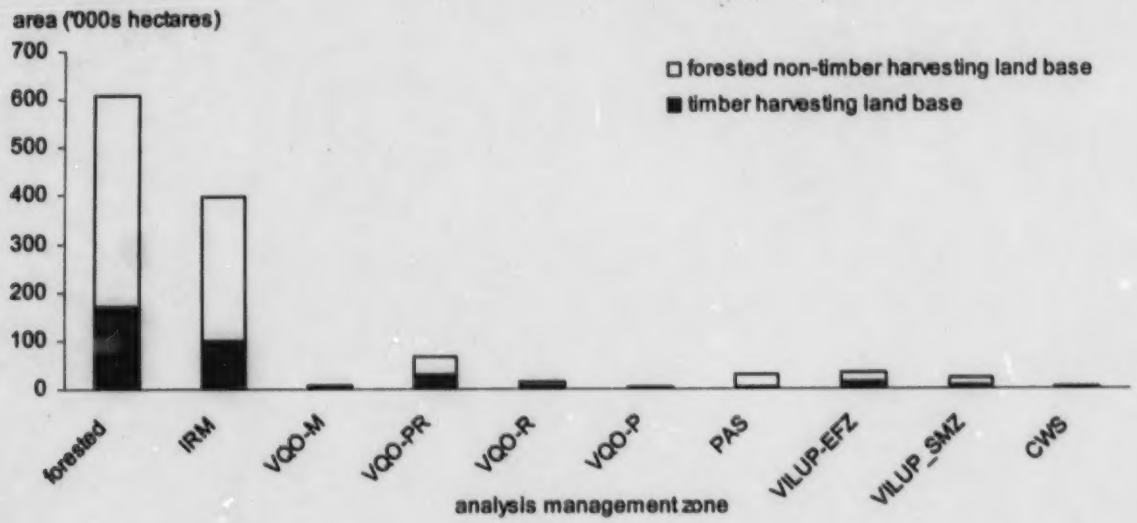

Figure 7. Management zones — Kingcome TSA forested land base, 2001.

2.4 Changes since the 1995 Kingcome TSA analysis

The size and availability of the timber harvesting land base, management practices, and modelling capabilities have changed since the last analysis for the Kingcome TSA. This section presents the major changes to the land base and forest management assumptions since the last analysis.

- Vegetation resource inventory — As described in Section 2.1, approximately 75% of the timber harvesting land base in the Kingcome TSA has been re-inventoried using the new VRI Phase-1 inventory standard. Although it is uncertain how the application of the VRI directly affects the size and nature of the timber harvesting land base, it is reasonable to assume the VRI provides more accurate information regarding the forest cover in the TSA
- Low site areas — In the previous timber supply analysis, forests classified as low site (Site="L") were excluded from the timber harvesting land base. In the current analysis a higher productivity standard was applied which excluded conifer stands, other than those that are cedar leading, that cannot achieve a minimum volume of 500 cubic metres per hectare by age 150. For cedar-leading stands the minimum volume is 350 cubic metres per hectare (340 cubic metres per hectare within the Hecate Lowlands). This difference has increased the average productivity of the timber harvesting land based compared to the previous analysis. The average site index is approximately two metres higher than in the previous analysis.
- Regeneration delay*— In this analysis the regeneration periods are between 1 and 3 years less than the previous timber supply analysis. The difference in the area-weighted average regeneration period is approximately 2.2 years. This may have a significant effect on the forecast since both analyses indicate a high level of sensitivity to green-up ages.
- Visual quality — In this analysis visual management objectives are applied to 'known' scenic areas which make up about 23% of the timber harvesting land base. In the previous analysis visual quality objectives were applied to a much larger area, about 43% of the timber harvesting land base.
- *Forest Practices Code* — Implementation of the *Forest Practices Code* has increased land base reductions for riparian reserves and wildlife tree patches.
- The use of a computer-based geographic information system (GIS) in this analysis has allowed for application of management requirements at a finer level than was achievable in the last analysis.

Regeneration delay
The period of time between harvesting and the date at which an area is occupied by a specified minimum number of acceptable well-spaced trees.

3 Timber Supply Analysis Methods

The purpose of this analysis is to examine both the short- and long-term timber harvesting opportunities in the Kingcome TSA under current forest management practices. A timber supply computer simulation model developed by the B.C. Forest Service was used for the analysis. A timber supply model, as distinct from a growth and yield model, assists the timber supply analyst in generating harvest forecasts (supply of timber over time) using a set of forest management assumptions. The simulation model uses information about the timber harvesting land base, timber volumes, and the management regime to represent how forests grow and are harvested over hundreds of years. There is no presumption that the future can be known hundreds of years from now; the analysis horizon simply reflects that forest-level changes often occur over very long time periods. Generally, only the results for the first 250 years are shown graphically in this report because the projected harvest remains constant after that time.

Similar to other models, the B.C. Forest Service model assumes that trees grow according to specified yield projections and are harvested according to either a volume target or a specified objective set by the analyst, such as harvest volume maximization. The Forest Service model also allows the use of forest cover guidelines that specify the desired age composition of the forest. These guidelines can be used to examine the effects of cutblock adjacency and green-up prescriptions. For example, guidelines might specify that no more than some maximum percentage of the forest can be younger than a specified green-up age, or that some minimum percentage of the forest must be in older age classes to provide wildlife habitat. The B.C. Forest Service simulation model facilitates examination of the effects of such guidelines on timber supply.

This type of analysis is used to determine the timber supply implications of a particular timber harvesting regime. The results of the analysis are especially important in determining allowable annual cuts (AAC) that will not restrict options of future resource managers, and that will assist local B.C. Forest Service staff to administer their programs according to relevant guidelines and principles. However, the results of the analysis are not meant to be taken as recommendations of any particular AAC.

The main results of the analysis are forecasts of potential timber harvests and timber inventory changes (ages and volumes) over time. Although this information gives field staff only very limited guidance in the design of operational activities such as harvesting block location and silviculture planning, it does help ensure that the timber harvest level supports rather than hinders sustainable forest management in the field.

4 Results

The base case harvest forecast presented in this section reflects an established strategy for managing the transition from current harvest levels to the long-term harvest level*.

Because forest management is inherently a long-term venture, uncertainty surrounds much of the information important in determining timber supply. This uncertainty will be discussed in Section 5, "Timber Supply Sensitivity Analyses." The base case provides only a part of the timber supply picture for the Kingcome TSA, and should not be viewed in isolation of the sensitivity analyses.

Section 2.4, "Changes since the 1995 Kingcome TSA analysis," provides an overview of the major changes to the land base and management assumptions since the last analysis. As noted in that section, any comparison between this and the last analysis should be made with recognition of the extent and nature of those changes. Each analysis should be evaluated in the context of the management regime and related data inputs and assumptions that applied at the time. Finally, one of the major reasons the chief forester is required under the *Forest Act* to periodically review the timber supply and AAC is to account for changes in management, information, and knowledge.

4.1 Base case forecast

The base case forecast for the Kingcome TSA represents current management within the Port McNeill Forest District as described in Appendix A of this report. Figure 8 shows the base case harvest forecast* for the Kingcome TSA. The initial harvest level is 1 319 000 cubic metres per year, 5.7% below the current AAC of 1 399 000 cubic metres. The harvest level declines by 10% after each of the first six decades to the level of 740 445 cubic metres per year which is maintained between decade 7 and decade 10. This is the lowest point in the forecast. After 100 years the harvest level increases by 15% per decade for two decades reaching a steady long-term level of 973 000 cubic metres per year. In this forecast the mid-term harvest level (decades 7 to 10) is 24% below the steady long-term level. This approximates the difference between the long-term level based on managed stand yields and the long-term level based on natural stand yields.

Long-term harvest level
A harvest level that can be maintained indefinitely given a particular forest management regime (which defines the timber harvesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.

Base case harvest forecast
The timber supply forecast which illustrates the effect of current forest management practices on the timber supply using the best available information, and which forms the reference point for sensitivity analysis.

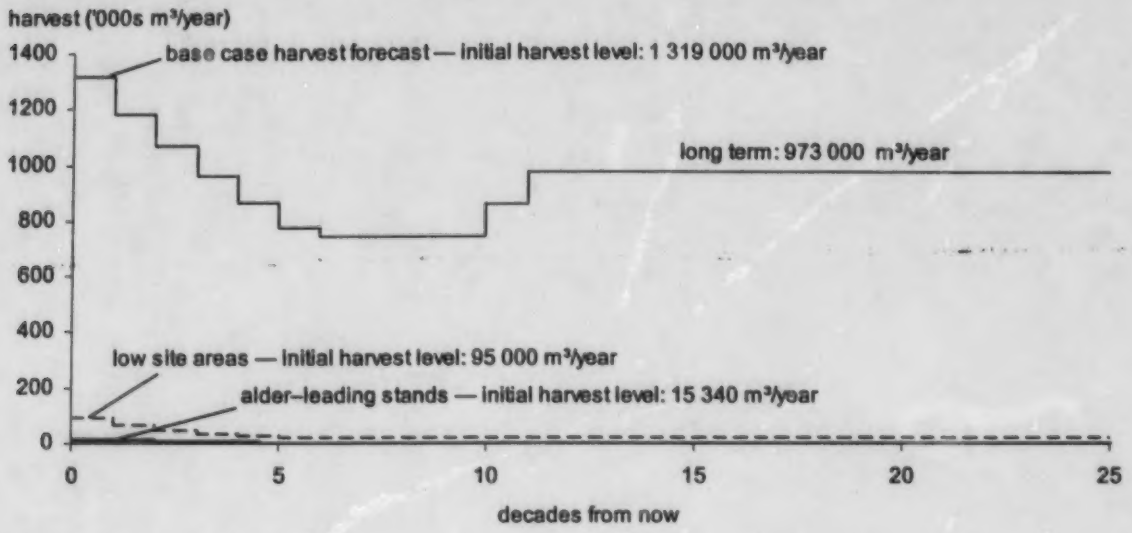

Figure 8. The base case harvest — initial harvest 5.7% below the current AAC — Kingcome TSA, 2001.

In the base case harvest forecast a portion of the total harvest comes from low-site coniferous stands. Harvesting in low-site coniferous stands contributes up to 95 000 cubic metres per year in the first decade. After the first decade the low-site harvest level declines by 25% per decade for three decades and 15% after the fourth and fifth decade to a steady long-term level of 28 000 cubic metres per year.

Harvesting of red alder stands is initially set to 15 340 cubic metres per year for the first decade, 10 000 cubic metres per year for the second decade and 5000 cubic metres for a third decade before declining to zero after 50 years. The harvest levels in red alder stands decline over time because as red alder stands are harvested, planting with red alder is held to a maximum of 20 hectares per year. The remaining area is reforested with mostly coniferous species.

Unsalvaged losses due to natural forces such as insects, wind and fire are estimated to be 13 583 cubic metres per year for the entire 250-year horizon and have been subtracted from all harvest forecasts shown in this report. Details of the unsalvaged losses are contained in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis."

4 Results

The long-term harvest level was defined as the maximum harvest rate at which the total timber growing stock* is maintained at a relatively even level. A stable growing stock indicates that harvesting can continue at that level in perpetuity. Figure 9 shows the change of timber harvesting land base inventory volume or growing stock over time for the base case harvest forecast. At the beginning of the forecast the majority of stands in the TSA are either very young, with little or no volume, or very old. The total inventory is initially at about 56 million cubic metres and declines over the first decades of the forecast as the existing mature stands are harvested and replaced by young managed stands. After 60 years managed stands make up over 50% of the total inventory volume. As managed stands mature the total growing stock increases to a level of about 47 million cubic metres.

The merchantable portion of the timber harvesting land base inventory volume is also shown in Figure 9. The merchantable inventory is defined as the volume of timber older than the minimum harvestable age, as defined in Appendix A. Initially, the merchantable inventory in the Kingcome TSA is about 50 million cubic metres or 89% of the total inventory. Over the first 50 years of the forecast the proportion of merchantable volume declines to approximately 50% of the total volume and then increases to levels of about 60% of the total inventory after the fifteenth decade.

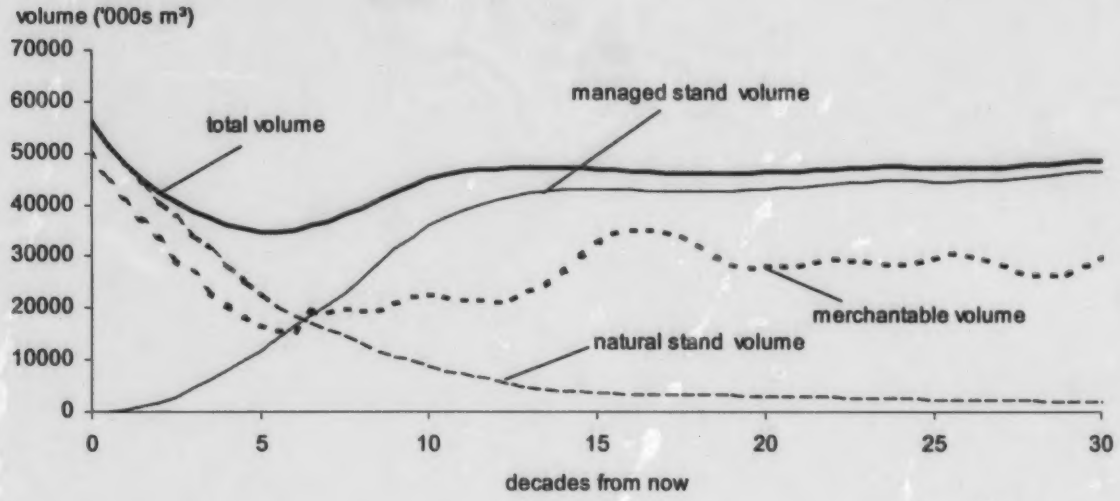

Figure 9. Natural, managed and merchantable growing stocks — Kingcome TSA timber harvesting land base, 2001.

Growing stock
The volume estimate for all standing timber at a particular time.

4 Results

Figure 10 shows the transition of harvesting from existing natural stands to managed stands, and the amount that each makes up in the base case harvest forecast. For the first five decades the harvest depends almost entirely on existing natural stands and declines at a rate of 10% per decade. During the period between decades 6 and 11, the harvest becomes dependent on managed stands. By decade 12 and onward, the harvest is projected to come predominantly from managed stands. At the same time, the growing stock for the timber harvesting land base shown in Figure 9 stabilizes, indicating a balance between growth and harvest.

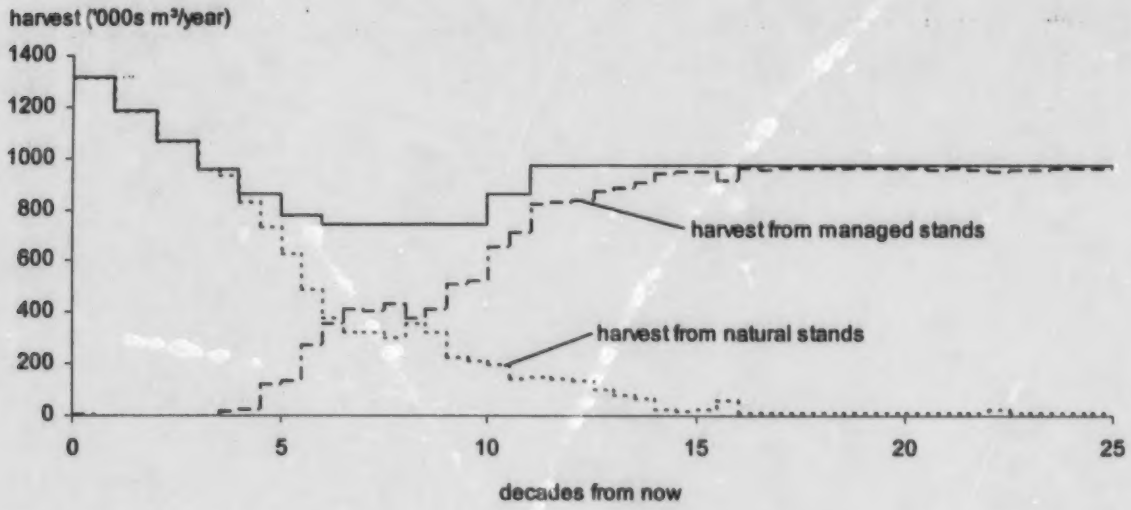

Figure 10. Harvest contribution from natural and managed stands — Kingcome TSA, 2001.

A small amount of harvesting in natural stands occurs late in the base case forecast. This volume is from a small portion of natural growing stock that is held in the timber harvesting land base to satisfy visual quality and biodiversity forest cover constraints.

The mean annual growth rate projected for managed stands over the long term is about 6.0 cubic metres per hectare per year (the total timber supply, including unsalvaged losses, divided by the future timber harvesting land base). The theoretical maximum growth rate for the TSA is estimated to be 6.4 cubic metres per hectare per year which would allow for a long-term harvest level of approximately 1 047 000 cubic metres annually. However, the projected long-term harvest level falls below this theoretical maximum since all stands cannot be harvested at the time of maximum productivity due to other management considerations on the land base and to meet the objective of maintaining a consistent harvest flow over time.

4.2 Area, average volume and average age harvested

Figure 11 shows the annual area harvested over the next 250 years for the base case forecast. These areas have not been adjusted to account for areas attributable to the volumes of unsalvaged losses.

Harvest volume is a function of the amount of area harvested and the volume of the stand harvested. In the base case, higher initial harvest levels for the first five decades are obtained by harvesting a larger area than is required to maintain the long-term harvest level. The average area harvested is initially 2137 hectares per year and decreases steadily over the first nine decades to a low of 1153 hectares per year at 100 years. After 100 years, the average area harvested fluctuates between 1200 hectares per year to 1600 hectares per year, with an average of approximately 1460 hectares per year for the remainder of the 250-year planning horizon.

4 Results

Figure 11 also shows the average volume per hectare harvested for each decade of the base case forecast. In the initial period the average yield from the older existing stands are slightly higher than the yield of stands forecasted for harvest in the mid-term. However, the average harvest volume per hectare increases as the focus of harvest shifts from natural to managed stands. The highest average volume harvested occurs in decade 21 when the average volume is 750 cubic metres per hectares.

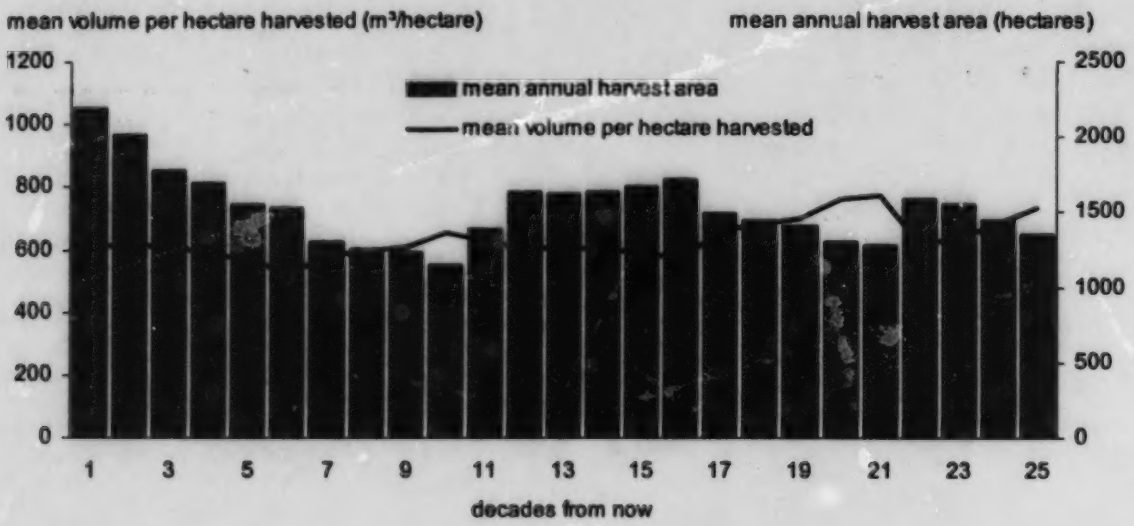

Figure 11. Average area harvested and average volume per hectare harvested over time — Kingcome TSA, base case harvest forecast 2001.

4 Results

Figure 12 shows the change in the area-weighted average harvest age resulting from the base case harvest forecast. Initially, as much as 98% of the timber supply comes from stands older than 250 years. The average harvested age decreases from an average of approximately 240 years to approximately 115 years in 50 years. After 50 years, the average harvested age in the base case harvest forecast fluctuates slightly around an average of approximately 113 years until the end of the planning horizon.

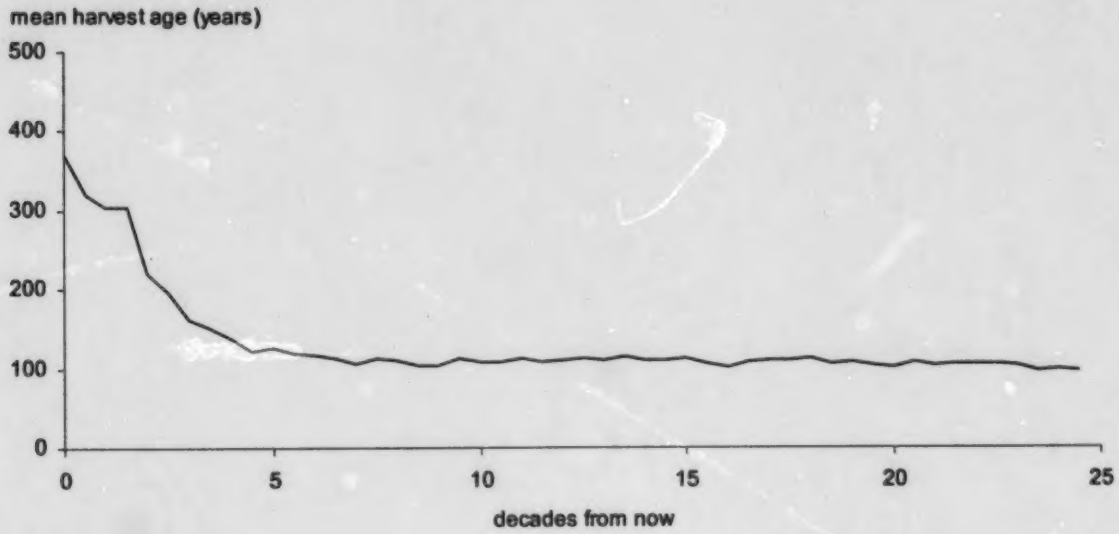

Figure 12. Average age of harvested stands over time — Kingcome TSA base case harvest forecast, 2001.

4.3 Age class profile over time

The charts in Figure 13 show how the age composition of the Kingcome TSA productive forest land base is predicted to change over the next 250 years under the base case harvest forecast.

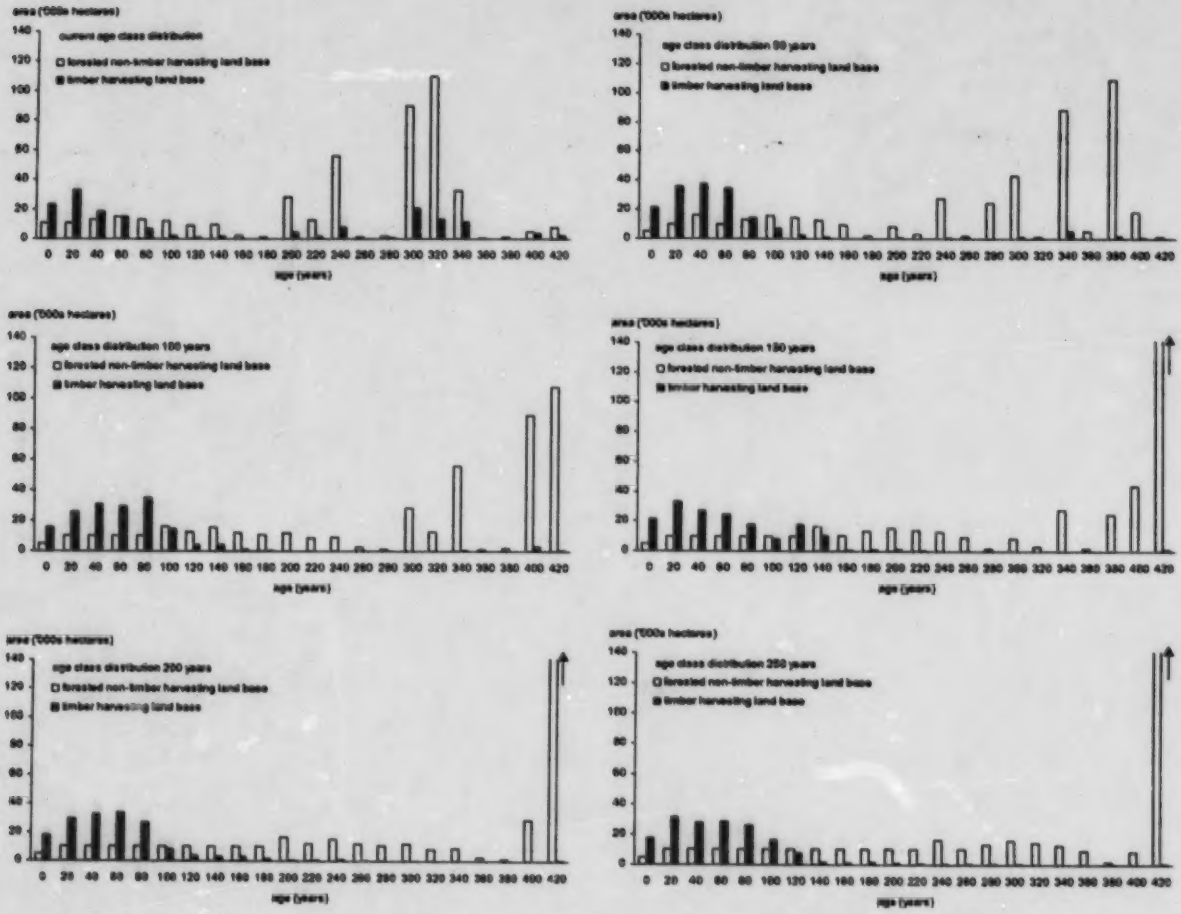

Figure 13. Changes in age composition on the productive Crown forest over time — Kingcome TSA base case harvest forecast, 2001.

4 Results

There are approximately 586 345 hectares of productive Crown forest within the Kingcome TSA analysis area, of which 168 726 hectares makes up the current timber harvesting land base. The current age class distribution shows that about 59% of the timber harvesting land base is comprised of stands distributed fairly evenly between 0 and 100 years. These are primarily areas where previous harvesting has occurred. Approximately 31% of the timber harvesting land base is currently occupied by stands older than 250 years, which are considered to meet old-seral conditions for landscape-level biodiversity. Only about 10% of the stands within the timber harvesting land base are between 100 and 250 years old. The productive Crown forest land base contains stands that have been excluded from the timber harvesting land base. Of these 'non-timber harvesting land base' stands, 83% are older than 100 years and 56% are older than 250 years. In total, almost 50% of the productive Crown forest is comprised of stands greater than 250 years of age.

One consequence of the large proportion of forested stands outside the timber harvesting land base is that a relatively small proportion of the timber harvesting land base needs to be reserved from harvest to meet old seral* landscape-level biodiversity objectives until stands outside the timber harvesting land base grow older. In addition, because more than 50% of the stands on the timber harvesting land base are at or above the minimum harvestable age, there is a great deal of timber harvest opportunity in the early periods of the forecast, even if older stands must be reserved to meet old-seral objectives.

Figure 13 shows that over the first ten decades, as harvesting moves progressively into second-growth stands, the age class distribution on the timber harvesting land base becomes more even (similar area within each age group). By the twentieth decade most of the natural stands within the timber harvesting land base are harvested and the portion above 100 years decreases. Figure 13 also shows that the area on the non-timber harvesting land base is comprised of stands distributed fairly evenly between 0 and 100 years of age. The presence of younger stands in the non-timber harvesting land base suggests that there is some amount of natural disturbance that is reverting stands to an early age. To reflect this disturbance in the analysis, all forecasts incorporate a disturbance rate of 500 hectares per year within stands wholly excluded from the timber harvesting land base which reverts these stands from an old age to a young age. This ensures that all age classes are represented in the non-timber harvesting land base throughout the planning horizon, and not all of the non-timber harvesting land base will contribute to meeting old-seral objectives. As a result, some older forest may be retained on the timber harvesting land base until late in the forecast, when there is sufficient non-timber harvesting land base to meet old-seral objectives.

Old seral
Old seral refers to forests with appropriate old forest characteristics. Ages vary depending on forest type and biogeoclimatic variant.

5 Timber Supply Sensitivity Analyses

The best available information on forest inventories and management practices is used to analyse the timber supply implications of continuing with current management. However, forest management is a complicated endeavor that must account for diverse and changing human values, the dynamics of complex ecosystems, and fluctuating and uncertain economic factors. As well, forests grow quite slowly in terms of human life spans, which means that decisions we make today have not only short-term but also long-term effects. In such a context, we cannot be certain that all data accurately reflect the current state of all values in the forest, how the forest will change, or how our management activities will affect the forest.

One important way to deal with this uncertainty is to revise plans and analyses frequently to ensure they incorporate up-to-date information and knowledge. Frequent planning and decision-making can help minimize any negative effects that may occur if decisions are based on inaccurate information. Frequent revision can also ensure that opportunities that become apparent from new information are not missed.

Another important way of dealing with uncertainty is to assess how values of interest, for example, timber supply, could change if the information used in the analysis is not accurate. Sensitivity analysis* is one way of evaluating how uncertainty could affect analysis results, and ultimately decision-making. Sensitivity analysis can highlight that fairly small uncertainties about some variables could have large effects on timber supply projections, or conversely that fairly large inaccuracies in others could have negligible effects. Also, sensitivity analysis could show that some variables affect timber supply more in the short term than in the long term, while others have the opposite effect. Sensitivity analysis can highlight priorities for collecting information for future analyses, and show which variables, and associated uncertainties, have the most significance for decisions. It can clarify whether current best estimates provide safe bases for decisions, or whether high uncertainty about important variables means more conservative decisions may be wiser.

In this section, results of several sensitivity analyses are discussed. Sensitivity analyses are intended primarily to test the relative change (i.e., high *versus* low sensitivity) in the harvest forecast resulting from changes in forest management assumptions and data used in the base case.

Sensitivity analysis
A process used to examine how uncertainties about data and management practices could affect timber supply. Inputs to an analysis are changed, and the results are compared to a baseline or base case.

5 Timber Supply Sensitivity Analyses

5.1 Alternate harvest flows over time

The base case harvest forecast presents one strategy for managing the decline from the current AAC to the long-term harvest level. Many other harvest flow patterns area possible. Figure 14, presents the two alternative harvest flows. Both are based on the same assumptions regarding forest management, growth and yield and forest inventory as the base case but apply different harvest targets in the short- and mid-term periods. The long-term harvest level is the same in all forecasts.

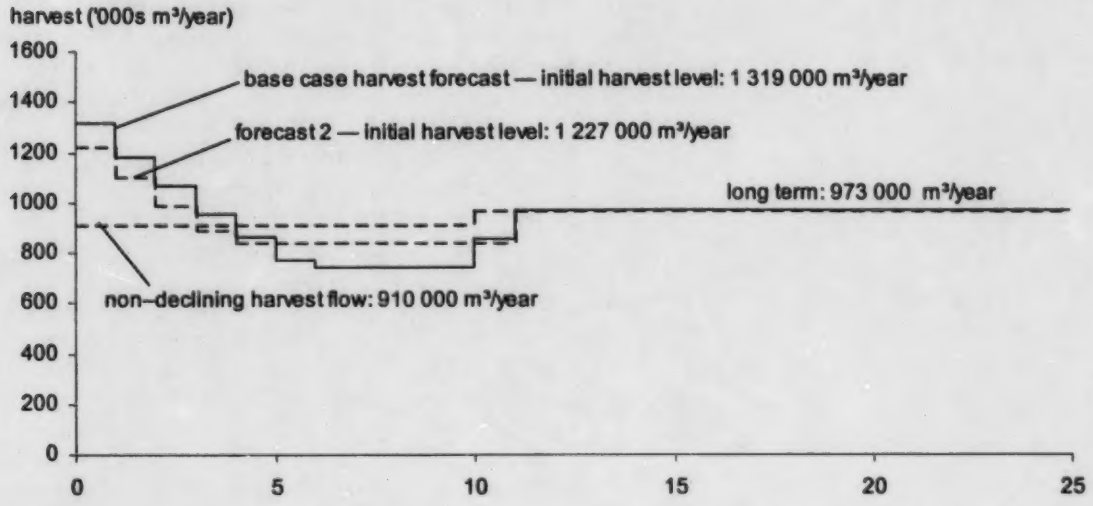

Figure 14. Alternate harvest forecasts including non-declining harvest flow — Kingcome TSA, 2001.

Alternative harvest forecast 2

- An initial harvest level of 1 227 000 cubic metres per year, 7% below the base case forecast and 12.3% below the current AAC, is sustained for one decade.
- The harvest level declines by 10% after each of the first three decades and then by 4% after the fourth decade to the lowest level of 844 000 cubic metres per year, 14% above the lowest level in the base case forecast.
- After 100 years the harvest level increases by about 13.3% to the steady long-term level of 973 000 cubic metres per year.

Non-declining harvest level forecast

- An initial harvest level of 910 000 cubic metres per year can be maintained for 10 decades before increasing to a long-term harvest level of 973 000 cubic metres per year.
- The initial harvest is 31.9% below the initial harvest level of the base case forecast.
- The long-term harvest level is the same as the base case forecast.

5.2 Sensitivity to changes in approximations used to model cutblock adjacency guidelines

As explained in Section 2.3, "Management practices," the rate of harvest within the Kingcome TSA is regulated by guidelines that limit the concentration of timber harvesting in any given area. These guidelines limit the size of harvest blocks and specify the conditions that must be achieved before stands adjacent to cutblocks can be harvested. To approximate these guidelines in the analysis an assumption was made that no more than 25% of the harvestable area in each landscape unit, apart from visually constrained areas, can be below the 'green-up' height. The green-up period is the length of time it takes an average stand, within a landscape unit, to achieve a top-height of three metres. The value of 25% is based on an estimate that it would require, on-average, four passes to harvest all of the merchantable timber within a landscape unit while meeting the adjacency guidelines.

The extent to which the 25% maximum limit represents the actual constraint on harvesting from the adjacency guidelines is uncertain. Where the timber harvesting land bases occurs in large contiguous patches, the 4-pass constraint (25% maximum) is appropriate. In other areas, where harvest blocks are interspersed among inoperable or other non-contributing forests, harvesting may be completed in 3-passes (33% maximum). As well, there may be other areas where a more restrictive, 5-pass regime (20% maximum), may better reflect the number of harvest passes required.

To test the sensitivity of the harvest forecast to changes in this assumption, two additional forecasts were generated. One forecast assumed that a maximum of 33% of the timber harvesting land base in each landscape unit could be less than the green-up height. The other assumed that a maximum of 20% could be less than the green-up height. Figure 15 illustrates the harvest forecast under these assumptions relative to the base case forecast.

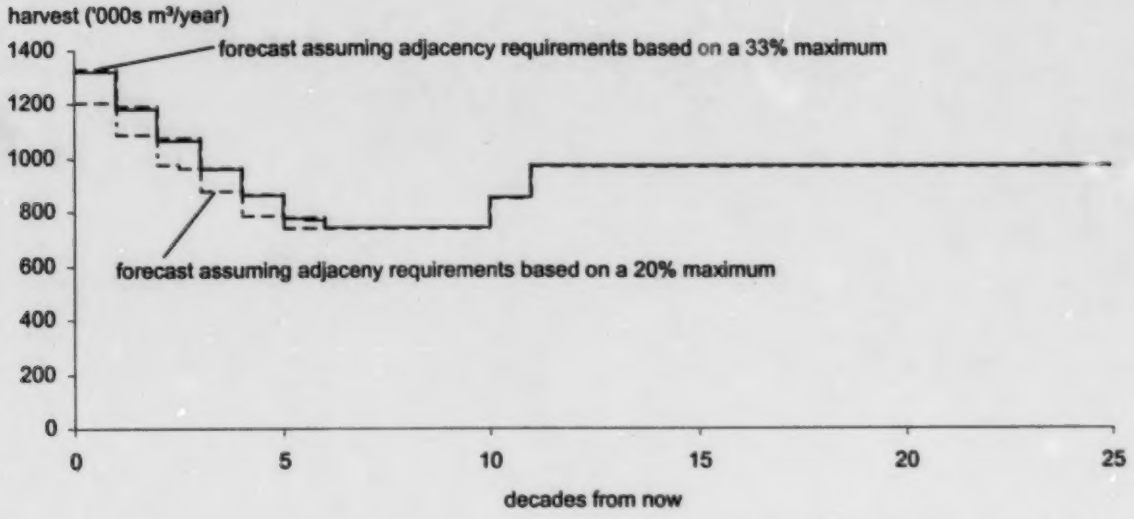

Figure 15. Forecasts assuming the 33% and 20% area in each landscape unit that can be harvested within a green-up period — Kingcome TSA, 2001.

5 Timber Supply Sensitivity Analyses

Forecast assuming 33% of the harvestable area in each landscape management unit can be less than the 'green-up' height

- An initial harvest level of 1 332 000 cubic metres per year can be maintained for 10 decades, 1.0% higher than the base case forecast.
- Long-term harvest level is the same as the base case forecast.

Forecast assuming 20% of the harvestable area in each landscape management unit can be less than the 'green-up' height

- An initial harvest level of 1 211 000 cubic metres per year can be maintained for 10 decades, 8.2% lower than the base case forecast.
- Long-term harvest level is the same as the base case forecast.

A three metre green-up height was used in most of the Kingcome TSA. The exceptions were the five enhanced forestry zones (EFZ) on Vancouver Island where a 1.3 metre green-up height was assumed. The EFZs collectively cover approximately 15 800 hectares or 9% of the timber harvesting land base. The age at which stands achieve green-up height was estimated for each landscape unit based on the mean site index. Green-up periods ranged between 10 and 16 years in the integrated resource management (IRM) zone and 7 and 9 years in the enhanced forestry zone.

Uncertainty about green-up ages stem from the potential for error or bias in the forest inventory and the length of time it takes to regenerate forests following harvesting. A sensitivity analysis was conducted which examined the impact of increasing and decreasing the green-up ages within the IRM and EFZ by 5 years. Figure 16 illustrates the results of this sensitivity analysis.

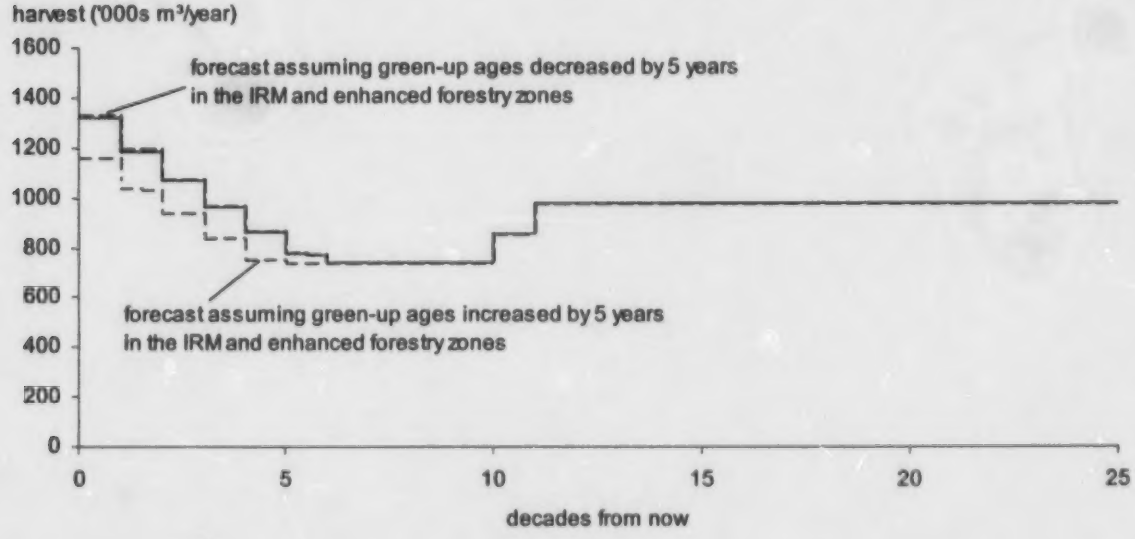

Figure 16. Forecasts assuming the green-up ages in the integrated resource management and enhanced forestry zones are increased and decreased by 5 years — Kingcome TSA, 2001.

Forecasts assuming the green-up ages in the integrated resource management (IRM) and enhanced forestry zones are 5 years shorter

- An initial harvest level of 1 334 000 cubic metres per year can be maintained for 10 decades, 1.1% higher than the base case.
- Long-term harvest level is the same as the base case.

Forecasts assuming the green-up ages in the integrated resource management (IRM) and enhanced forestry zones are 5 years longer

- An initial harvest level of 1 160 000 cubic metres per year can be maintained for 10 decades, 12.1% lower than the base case forecast.
- Long-term harvest level is the same as the base case forecast.

The above results indicate that the short-term harvest supply is sensitive to cutblock adjacency assumptions. If a 5-pass harvest is assumed for most areas of the TSA, the short-term harvest rate is reduced by 8.2% compared to the base case harvest forecast. If green-up ages are increased by 5 years in the IRM zone and EFZ, the short-term timber supply is reduced by 12.1%.

Relaxing the adjacency constraints by assuming a 3-pass harvest across the TSA or by reducing the green-up ages by 5 years only increases the short-term harvest by a small amount, about 1.1%. This indicates that other rate-of-harvest constraints may be limiting in the short term. The long-term harvest level is unaffected by changes in these adjacency assumptions.

5.3 Sensitivity to an increase in the amount of visually sensitive area

In addition to cutblock adjacency guidelines, the rate of harvest is further constrained by visual quality guidelines in areas for which scenic values are to be maintained when carrying out forest development. These areas were identified by the district manager after careful consideration of the level of recreational use and terrain and forest cover characteristics of each area. In addition to scenic areas that have been made known by the district manager, additional visually sensitive areas have been identified in a visual landscape inventory conducted for the Kingcome TSA. Sensitivity analysis was conducted to test the affect of applying the visual quality guidelines to all visually sensitive areas within the visual landscape inventory. The results are presented in Figure 17.

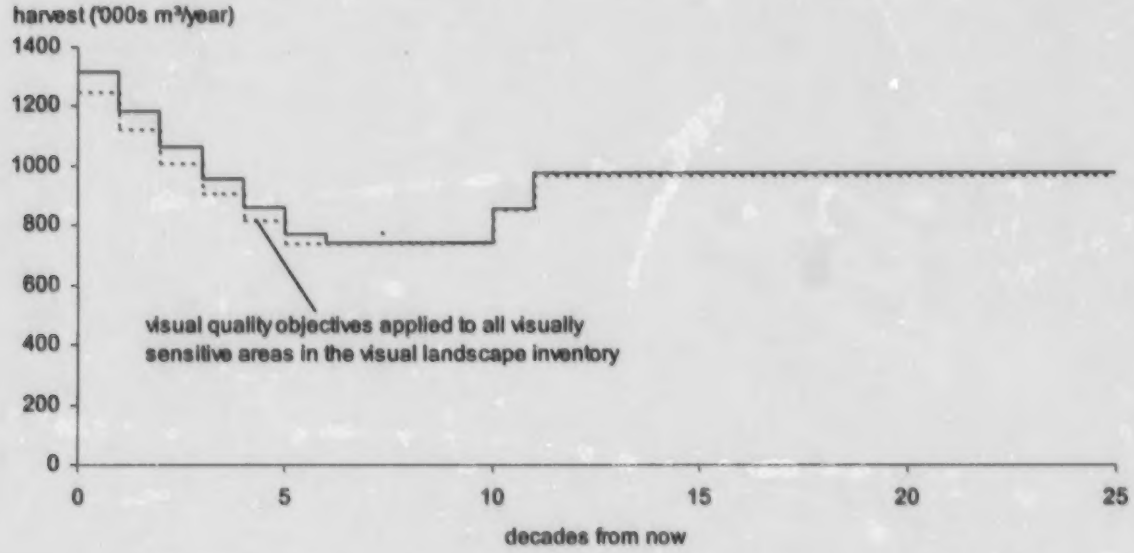

Figure 17. Forecast assuming visual quality objectives applied to all visually sensitive areas in the visual landscape inventory — Kingcome TSA, 2001.

Forecast assuming visual quality objectives applied to all visually sensitive areas in the visual landscape inventory

- An initial harvest level of 1 252 000 cubic metres per year can be maintained for 10 years, 5.1% lower than the base case forecast.
- Long-term harvest level is the same as the base case forecast.

5.4 Sensitivity to changes in the rate of disturbance allowed in scenic areas

Although visual quality objectives for known scenic areas in the Port McNeill Forest District have yet to be formally established, current practice has been to apply the recommended visual quality class (RVQC) when harvesting in these areas. The guidelines limit the proportion of young forests that have not achieved visually effective green-up (VEG) within known scenic areas. Visually effective green-up is assumed to be achieved when the regenerated stands grow to a top-height of 5 metres.

Visual quality guidelines were modelled in the base case harvest forecast by limiting the percentage of harvested area under the VEG age within the known scenic areas of individual landscape units. The maximum allowable disturbance not greened-up was assigned for each RVQC — landscape unit combination based on the visual absorption capacity of the areas as specified in the *Procedures for Factoring Visual Resources into Timber Supply Analyses* (March 1998). The maximum denudation applied in the base case were spread across the recommended ranges. These ranges are from 0% to 1% for areas in the 'preservation' RVQC, 1.1% to 5% for areas in the 'retention' RVQC, 5.1% to 15% for the 'partial retention' RVQC and 15.1% to 25% for the 'modification' RVQC. The average maximum denudation across all known scenic areas falls close to the middle of the recommended range for each RVQC type.

Sensitivity analysis was conducted to examine the impacts of assuming the maximum denudation for all RVQC—landscape unit combinations were at the high- and at the low-end of the recommended ranges. Figure 18 illustrates the results of this analysis.

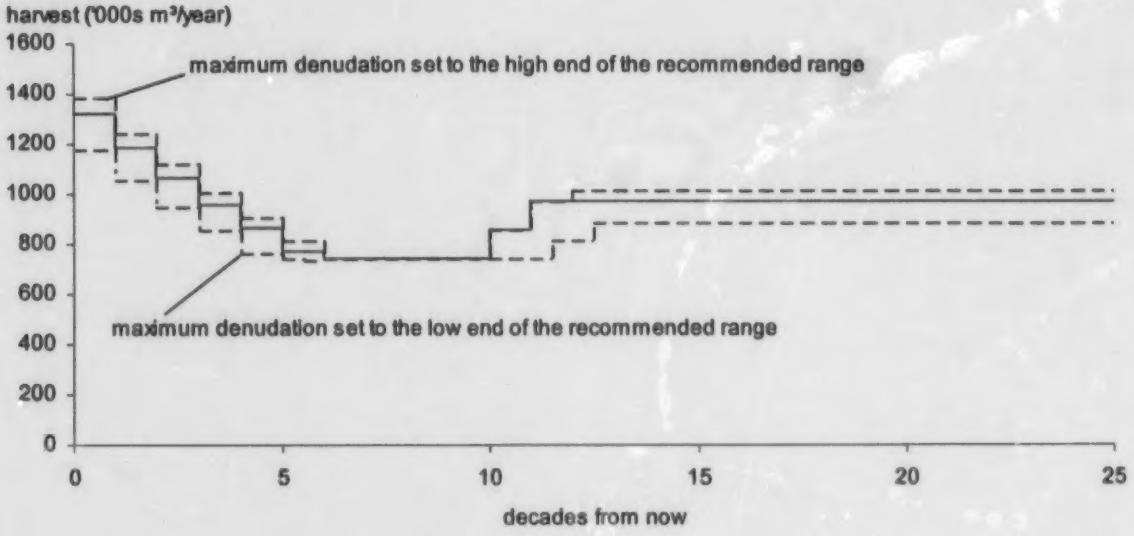

Figure 18. Forecasts assuming maximum denudation for visual quality classes set to the high- and low-end of the recommended ranges — Kingcome TSA, 2001.

Forecasts assuming maximum denudation for visual quality classes set to the high end of the ranges

- An initial harvest level of 1 385 400 cubic metres per year can be maintained for 10 years, 5.0% higher than the base case forecast.
- Long-term harvest level is 1 011 600 cubic metres per year, 4.0% higher than the base case forecast.

Forecasts assuming maximum denudation for visual quality classes set to the low end of the ranges

- An initial harvest level of 1 177 000 cubic metres per year can be maintained for 10 years, 10.8% lower than the base case harvest forecast.
- Long-term harvest level is 886 400 cubic metres per year, 8.9% lower than the base case harvest forecast.

These results indicate that Kingcome TSA timber supply is sensitive to the amount and type of constraints applied to visually sensitive areas. Specifically, if constraints are tightened, through application to all visually sensitive areas or by lowering the maximum denudation, the short-term harvest levels must be decreased. Relaxing constraints does not increase the short-term timber supply by the same magnitude suggesting that other rate-of-harvest constraints, such as cutblock adjacency, are also limiting harvest levels.

5.5 Sensitivity to change in the timber harvesting land base

The area estimated to be available for timber harvesting in the Kingcome TSA is based on assumptions regarding management objectives for forest values such as timber, wildlife habitat, biodiversity, and wilderness recreation; on the amount of environmentally sensitive area, and on assumptions about the economic feasibility of timber harvesting in different areas. Bias or error in these assumptions may cause the size of the timber harvesting land base to be over– or underestimated. Each of the above land base assumptions and the methods used to derive them are described in Appendix A, "Descriptions of Data Inputs and Assumptions for the Timber Supply Analysis."

Currently there is no indication that the timber harvesting land base has been significantly over- or underestimated. However there is some uncertainty regarding the land base reductions applied for riparian areas and wildlife tree patches. In the base case, 8.9% of the operable forest area was excluded from the timber harvesting land base as riparian management areas. There is uncertainty about the proportion of operable land base within riparian reserve zones and about the amount of timber harvesting that can occur within riparian management zones while adequately protecting resources values in these areas. The reduction for wildlife tree patches were based on guidelines set out in Table A.3.1 of the *Landscape Unit Planning Guide (LUPG)*. There is uncertainty regarding how much of the full wildlife tree patch requirement is met by non-contributing forest. In the base case it is assumed that 75% of the full requirement will be met from forests not in the timber harvesting land base.

5 Timber Supply Sensitivity Analyses

Since both the riparian area and wildlife tree patch reductions were applied as per cent netdowns to all operable stands in the land base, varying these percentage reductions effectively varies the proportion that all stands contribute to the timber supply. Four sensitivity analyses were done to provide information that may help evaluate the implications of any general increase or decrease in the size of the timber harvesting land base. These examine the results of arbitrarily increasing and decreasing the area of all stands by 5% and by 10%. Figure 19 illustrates the impact of these adjustments relative to the base case. The results show that the harvest forecast varies more or less in proportion to the amount the land base is increased or decreased. When the land base is decreased by 5% or by 10%, the annual harvest decreases by about 5% and 10%, respectively. When the timber harvesting land base is increased by 5% or by 10% the annual harvest increases by about 4% and 8% respectively.

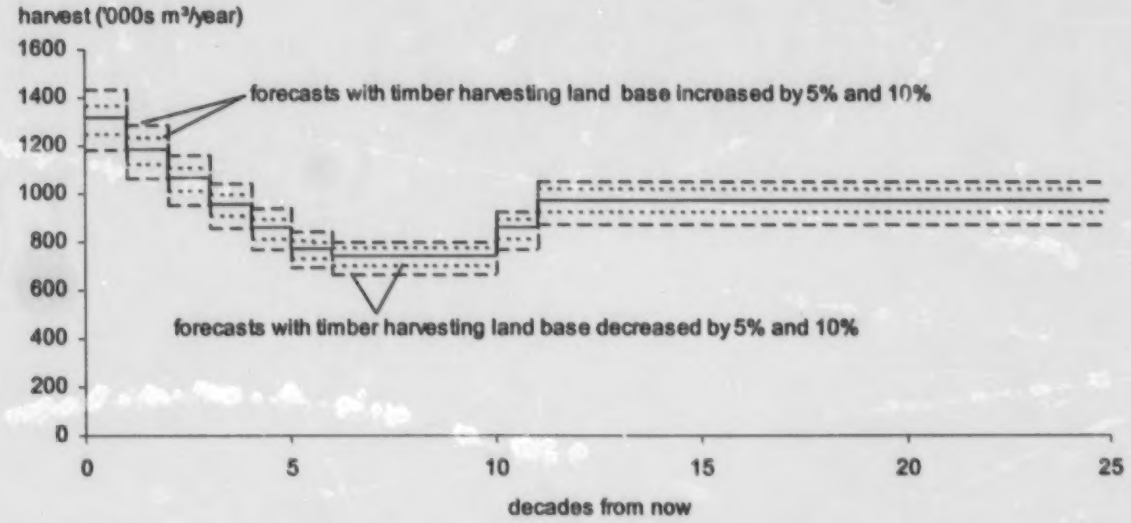

Figure 19. Land base sensitivity analysis — Kingcome TSA, 2001.

5.6 Sensitivity to an increased level of red alder management

The base case harvest forecast includes a harvest from red alder stands of 15 340 cubic metres per year for the first decade, 10 000 cubic metres per year for the second decade and 5000 cubic metres for a third decade before declining to a small harvest of 100 hectares of red alder that occurs periodically over the remainder of the forecast. The harvest of red alder declines over time because as red alder stands are harvested, reforestation is guided by a regional direction which allows for a maximum of 20 hectares per year to be planted with red alder over the first five years. The balance of the red alder area is reforested to hemlock types. This level of alder management is based on current management defined by an operational trial for red alder management in the Vancouver Forest Region.

5 Timber Supply Sensitivity Analyses

A sensitivity analysis was conducted to assess the timber supply implications of increasing the level of red alder management. This forecast assumes that 50% of the alder area harvested will be regenerated to red alder-leading stands. Figure 20 presents the resulting harvest forecasts showing only the volume of red alder harvested.

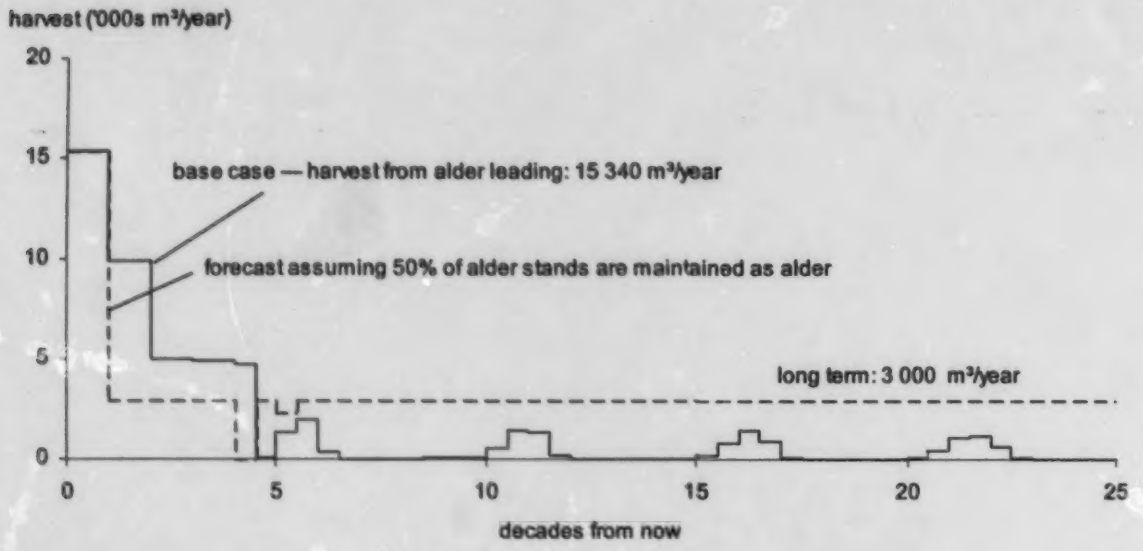

Figure 20. Forecast assuming 50% of the area of red alder harvested is reforested to red alder-leading stands — Kingcome TSA, 2001.

Regenerate 50% of the area of red alder harvested to red alder

- The red alder harvest is initially 15 340 cubic metres per year and after one decades declines to 3000 cubic metres per year.
- A shortfall in harvest occurs in the fifth decade after which the harvest of 3000 cubic metres is sustained.
- The total harvest of coniferous and deciduous stands (1 319 000 cubic metres per year) is unchanged from the base case harvest.

5.7 Sensitivity to excluding low-site forest from the timber harvesting land base

For the last timber supply review, Forest Service staff estimated that approximately 21 000 hectares of forest on low productivity sites could be harvested. These areas consisted largely of cedar and cypress stands located within the Nahwitti and Hecate Lowlands area of the TSA. In the 1996 AAC decision the chief forester determined that a partition of 130 000 cubic metres per year of the total AAC of 1 399 000 cubic metres should come from these low productivity sites.

A definition of low-site forest was developed for this analysis based on recent harvest performance in the low-site partition. These areas include cedar and cypress-leading stands with greater than 80% of their volume as cedar, with more than 340 cubic metres per hectare total volume and located in the Nahwitti and Hecate Lowlands but outside of conventional operability lines. Using this definition, 12 872 hectares of low-site forest were included in the timber harvesting land base which represents approximately 7.6% of the total timber harvesting land base. This does not include a significant area of poor-productivity cedar type located inside conventional operability lines.

The generally poor quality and low volume of timber in these low-site stands leads to uncertainty about the degree to which these stands should be included in the timber harvesting land base. Many low-site stands may not be profitable to harvest if log market values for cedar fall significantly below current levels. The effects of excluding low-site stands from the timber harvesting land base were tested in a sensitivity analysis. Figure 21 illustrates the harvest forecast generated when these stands are excluded from the timber harvesting land base.

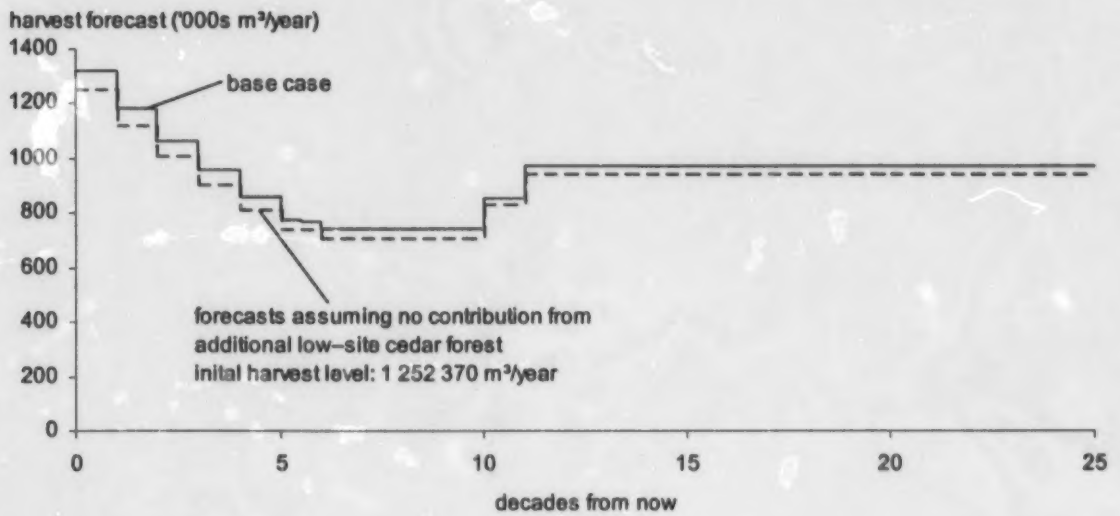

Figure 21. Harvest forecast when low productivity cedar stands are excluded from the timber harvesting land base — Kingcome TSA, 2001.

Low productivity cedar stands excluded from the timber harvesting land base

- An initial harvest level of 1 252 370 cubic metres per year (5.1% below the base case forecast) can be maintained for 10 years.
- Long-term harvest level is 948 335 cubic metres per year, 2.5% lower than the base case forecast.

Although 7.6% of the timber harvesting land base is within the low-site cedar type defined for this analysis, excluding these types from contributing to the TSA timber supply only decreases the harvest forecast by about 5.1% in the short term and 2.5% in the long term. This is not unusual given that the average stand volume and average productivity of stands in these types are well below the averages for the TSA.

5.8 Sensitivity to changes in yield estimates for existing stand

Timber volume estimates for existing natural stands are subject to uncertainty due to factors such as inaccuracies in the forest inventory information used to estimate timber volumes (estimated tree heights and stand ages) and the statistical process used to develop equations for predicting forest growth and yield. Existing stand yield estimates also depend on the assumptions regarding the amount of tree retention in the variable retention silvicultural system. The base case does not assume any reduced stand volumes attributable to the use of this silvicultural system. Sensitivity analysis was conducted to investigate the impact of varying natural stand yield estimates by 10%. The results of this analysis are illustrated in Figure 22.

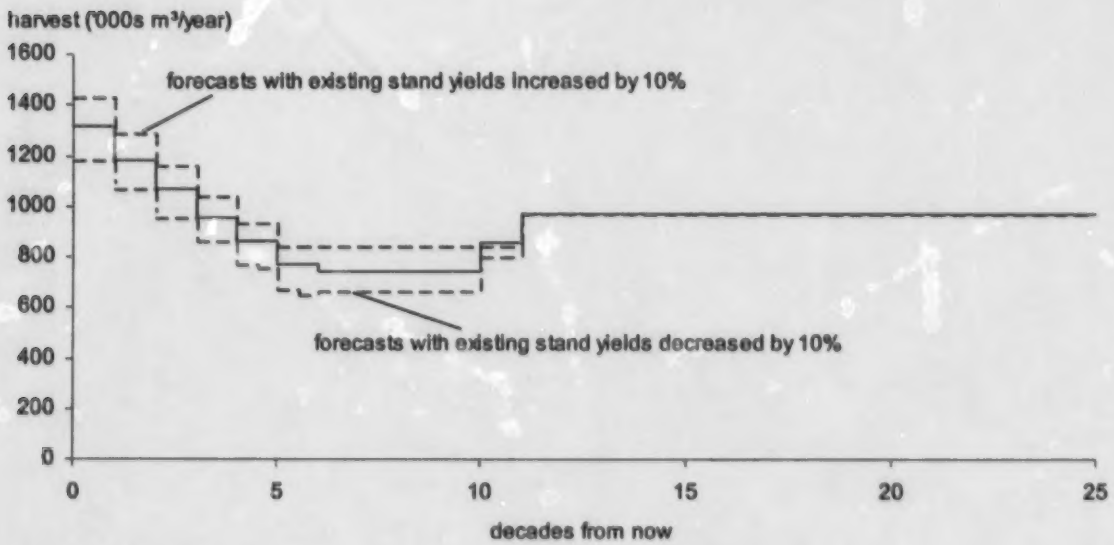

Figure 22. The effect on the harvest forecast of increasing and decreasing existing stand yields by 10%—Kingcome TSA, 2001.

Existing stand volume estimates increased by 10%

- An initial harvest level of 1 432 270 cubic metres per year, 8.6% above the base case forecast, which can be maintained for one decade.
- The long-term harvest is the same as the base case, 973 000 cubic metres per year.

Existing stand volume estimates decreased by 10%

- An initial harvest level of 1 185 740 cubic metres per year, 10.1% below the base case forecast, can be maintained for one decade and then must decline by 10% per decade.
- The long-term harvest is the same as the base case, 973 000 cubic metres per year.

5.9 Sensitivity to changes in yield estimates for managed stand

Uncertainty in volume estimates for managed stands exists for the same reasons listed for estimated existing stand yields (inaccuracies in the forest inventory and the growth and yield models), but also because of the limited experience and data that is available for regenerated managed stands in British Columbia. In this section, the timber supply effects of uncertainty associated with predicting volumes in regenerated stands are examined. Figure 23 shows the harvest forecasts that results when managed stand volumes are increased and decreased by 10%.

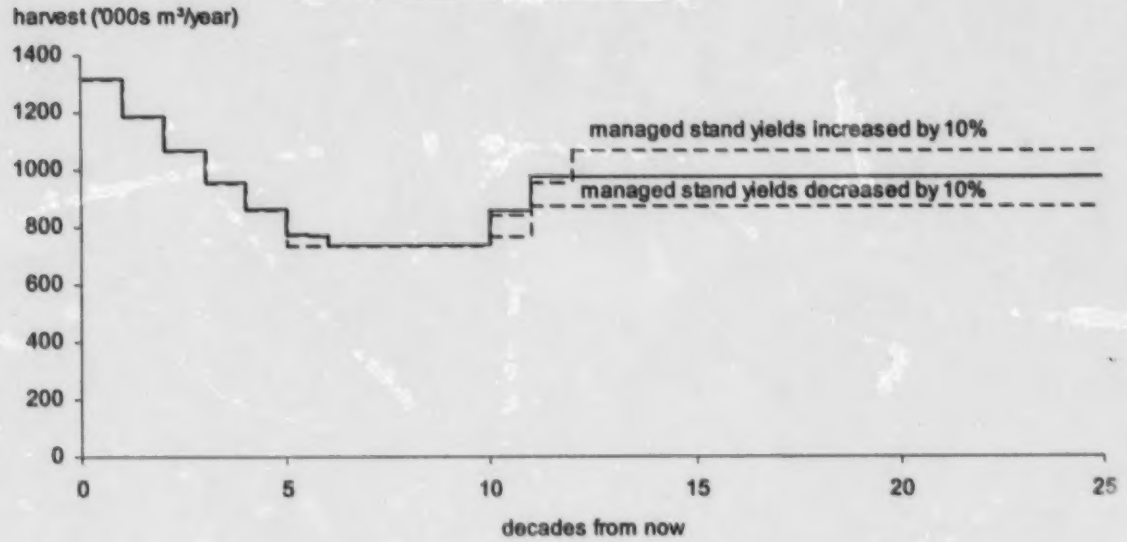

Figure 23. Effect on the harvest forecast increasing and decreasing volume estimates for managed stands by 10% — Kingcome TSA, 2001.

Managed stand volume estimates increased by 10%

- Initial- and mid-term harvest level the same as in the base case forecast.
- Long-term harvest level is 1 071 660 cubic metres per year, 10.1% above the base case forecast.

Managed stand volume estimates decreased by 10%

- Initial- and mid-term harvest level the same as in the base case forecast.
- Long-term harvest level is 874 600 cubic metres per year, 10.2% below the base case forecast.

5.10 Sensitivity to volume gains from the use genetically improved seed

Reforestation following harvesting is required by law in British Columbia and reforesting with selected orchard seedlings (if available) is a requirement of the *Forest Practices Code*. For the past 40 years the province has been selecting and breeding trees with desirable traits such as faster growth, better stem and wood quality, and resistance to diseases and insect attack. Tree breeding offers potential gains in timber supply through increases in growth rate that may reduce minimum harvestable ages and increase volume at time of harvest. In this sensitivity analysis, genetic gain estimates forecasted to come from seed provided by local, ecologically appropriate, orchards were applied.

Table 4 lists the expected gain (genetic worth) in stem volume at age 80 from the use of improved seed for hemlock and redcedar. The estimates were adjusted to account for seed production and availability reported for each seed zone in the TSA in the year 2000.

Table 4. Tree improvement gains

Species	Volume gain at 80 years
Western hemlock	2.5%
Redcedar	5.2%

A forecast was generated from managed stand yield tables (MSYT) that reflected the volume increases shown in Table 4. This forecast has a long-term harvest 3.3% higher than the base case forecast. Application of the full volume gains assumes that all existing and future managed stands established with improved seedlings will realize the full genetic gain. Ingress of natural seedlings may reduce actual gains achieved. Conversely, these increases may understate actual future gains if the use of improved seed increases from the 2000 level assumed in this sensitivity analysis.

5.11 Sensitivity to changes in minimum harvestable ages

Minimum harvestable ages are an estimate of the time needed for stands to reach a merchantable condition. The time at which stands will become merchantable is not known with precision because of uncertainty about the growth of regenerated stands, and an inability to foresee future conditions that will determine merchantability. In the Kingcome TSA, minimum harvestable ages have been chosen to maximize long-term volume yield.

In the base case, minimum harvestable ages for existing and managed stands were determined based on achieving approximately 95% of the culmination of mean annual increment, and a minimum volume of 350 cubic metres per hectare for cedar, 500 cubic metres per hectare for other coniferous stands and 300 cubic metres per hectare for red alder stands. The resulting minimum harvestable ages range from 50 to 150 years, depending on species and site index, and are described by leading species in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." Approximately 53% of the existing timber harvesting land base in the Kingcome TSA is currently at or above the minimum harvestable age applicable to the stand. The minimum harvestable ages are minimum; in this analysis stands may be harvested at older, but not younger, ages. Minimum harvestable ages are meant to approximate the timing of merchantability and are not legal or policy requirements.

Sensitivity analysis was undertaken to assess the timber supply implications of uncertainty about these minimum harvestable ages.

Decrease minimum harvestable ages by 5 years

- An initial harvest level of 1 345 650 cubic metres per year, 2.0% above the base case forecast, which can be maintained for one decade.
- The long-term harvest level of 973 000 cubic metres per year is the same as in the base case.

Increase minimum harvestable ages by 5 years

- An initial harvest level of 1 285 680 cubic metres per year, 2.5% below the base case forecast, which can be maintained for one decade.
- The long-term harvest level of 973 000 cubic metres per year is the same as in the base case.

5.12 Sensitivity to changes in productivity estimates for future stands

The productivity of a site largely determines how quickly trees will grow. It therefore affects the timber volumes in regenerated stands, the age at which stands achieve green-up and the age at which those stands will reach merchantable size. The most accurate estimates of site productivity come from stands between 30 and 150 years old. At ages less than about 30 years a temporary increase or decrease in growth due to factors such as a post-harvest flush of nutrients or an unusual drought year can affect the overall productivity estimated for the stand. Site productivity estimates derived from older stands may be incorrect because tree heights do not represent actual productivity — for example, due to top breakage — and it is very difficult to determine ages of old trees accurately.

The results of recent province-wide research suggest that the estimated post-harvest productivity of sites currently occupied by old-growth stands may be significantly underestimated. Two Old-Growth Site Index (OGSI) studies applicable to timber supply forecasting are:

- *Site index adjustments for old-growth stands based on paired plots* (Nussbaum 1998). Data were obtained from paired plots installed in old-growth stands and adjacent logged and regenerated stands of the same productivity. Site index was estimated for both and comparisons were made. Results are applicable to lodgepole pine, interior spruce and coastal Douglas-fir only.
- *Site index adjustments for old-growth stands based on veteran trees* (Nigh 1998). The objective of the study was to develop site index adjustments for species not covered by the paired-plot project. The data for this study came from temporary and permanent plots with a veteran and main stand component. The site indices for the two components were estimated and an adjustment equation for each species was derived using linear regression analysis. The results of the study are considered less reliable than those from the paired-plot study.

To test the sensitivity of the base case harvest to uncertainty about site productivity estimates, an analysis was performed that incorporated adjustments to site indices. Site indices of cedar-leading and hemlock-leading stands older than 140 years and with site indices that fall within the ranges sampled in the veteran-tree study were adjusted using the veteran-tree results. Managed stand volume estimates for those analysis units affected by changes in estimated future productivity were recalculated based on the average adjusted site productivity. Green-up ages and minimum harvestable ages were also recalculated. Table 5 compares the average forest inventory-based site index for each tree species group to those defined using each of the adjustments. The adjustments suggested by this research reflect the potential site productivity that might be achieved under optimal conditions. Realistically, growth conditions are seldom optimal because of competition from other trees and brush. Therefore, some stands may not achieve the maximum potential productivity suggested by the research.

Table 5. Average analysis unit site index based on forest inventory and adjusted for old-growth site index information — Kingcome TSA, 2001

Analysis unit	Timber harvesting land base (hectares)	Mean area weighted inventory site index (m @ 50 years breast height age)	Mean area weighted adjusted site index[a] (m @ 50 years breast height age
Cedar — good	16 569	23.4	23.8
Cedar — moderate	24 366	16.4	20.8
Cedar — poor	32 828	13.4	17.7
Hemlock — good	27 674	28.8	28.9
Hemlock— moderate	33 744	22.4	23.0
Hemlock — poor	24 925	16.1	24.3

(a) Means shown are for all stands in the analysis unit including stands over 140 years in age to which site index adjustments were applied and stands 140 years old or younger for which no adjustments were applied.

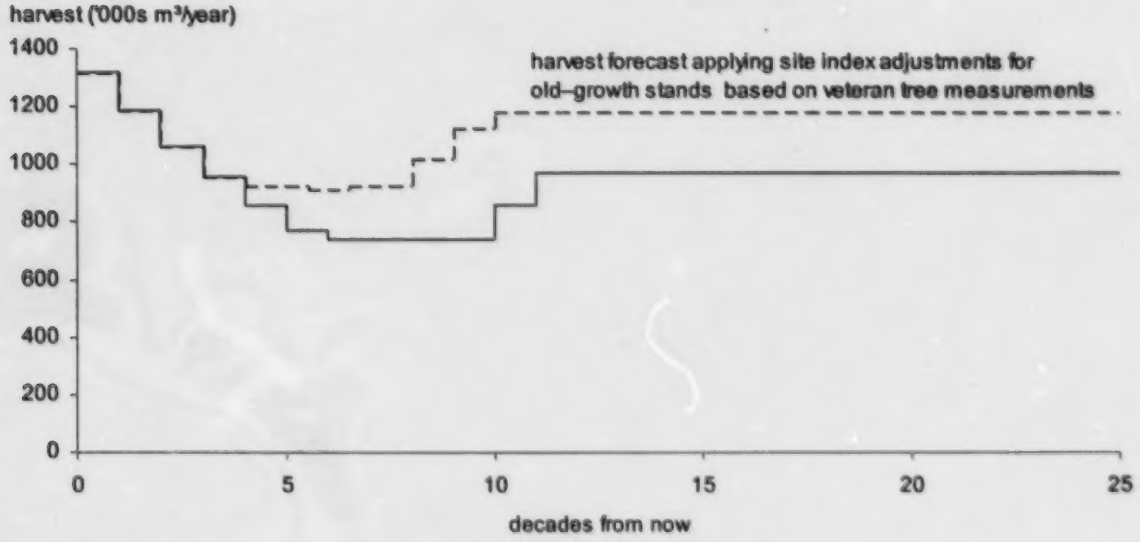

Figure 24. Harvest forecast based on OGSI (veteran tree study) site index adjustments — Kingcome TSA, 2001.

Old-growth site index (OGSI) adjustments

- No effect on the initial timber supply compared to base case.
- The sustainable long-term harvest level is 1 182 400 cubic metres per year, 21.4% higher than in the base case forecast.
- The mid-term harvest level, when the harvest levels are at the lowest point in the forecast, is 925 000 cubic metres per year, 25.1% higher than in the base case.

The effect on harvest flow illustrated here must be viewed cautiously for the reasons discussed above, as it provides an upper limit on the likely impacts of improved site productivity information. It is unclear how well actual second-growth stands are growing relative to the theoretical maximums. However, the results of the sensitivity analysis do provide insight into the trends associated with possible adjustments to site productivity estimates for the Kingcome TSA.

5.13 Sensitivity to the application of landscape-level biodiversity requirements

The *Forest Practices Code Act of British Columbia (FPC)* describes the conservation of biodiversity as an essential component of sustainable forest use. The *FPC Landscape Unit Planning Guide* provides recommendations for maintaining biodiversity at both the stand- and landscape-levels. Stand-level biodiversity has been addressed in this analysis by removing portions of each stand from the timber harvesting land base for wildlife tree patches (WTP). Therefore, uncertainty about stand-level biodiversity can be assessed through sensitivity analysis that examines the changes to the size of the land base available for timber harvesting.

Management for landscape-level biodiversity was modelled in this analysis through the use of forest cover requirements applied to each combination of natural disturbance type (NDT)* biogeoclimatic subzone, and variant within each landscape unit. In the base case forecast, old-seral requirements, as found in the *Landscape Unit Planning Guide*, were applied at the biogeoclimatic variant level within each draft landscape unit. These requirements were modelled using a single weighted constraint based on the anticipated distribution of 45% low-, 45% intermediate- and 10% high-biodiversity emphasis. The low emphasis portion of the old-growth forest cover requirement is phased in over time, allowing for an initial two-thirds reduction of the old-forest requirement in low-emphasis portions of landscape units, as directed by provincial policy.

While the approach used initially represents current policy for managing and modelling landscape-level biodiversity, there is uncertainty about how the recommendations in the *Landscape Unit Planning Guide* will be applied once landscape units and biodiversity emphasis options (BEOs) are declared. Three sensitivity analyses were performed to evaluate the potential timber supply impacts associated with uncertainty about landscape-level biodiversity management.

Natural disturbance type (NDT)
An area that is characterized by a natural disturbance regime, such as wildfires, which affects the natural distribution of seral stages. For example areas subject to less frequent stand-initiating disturbances usually have more older forests.

Full old-seral requirements applied immediately based on draft BEOs for each landscape unit (i.e., no phase-in for low emphasis landscape units)

- No effect on timber supply compared to the base case forecast in either the short- or long-term.

Mature and full old-seral requirements applied immediately based on draft BEOs for each landscape unit

- No effect on timber supply compared to the base case forecast in either the short- or long-term.

Early, mature+old and old-seral requirements applied immediately based on draft BEOs for each landscape unit

- Temporary timber supply shortfall of 7% in the 10-year period between 45 and 55 years from now.

Immediate, full application of all the seral stage targets in the *Landscape Unit Planning Guide* has little timber supply impact. This is due in part to the large amount of available timber of harvestable age in the Kingcome TSA, as well as the relatively large amount of forests outside the timber harvesting land base that can be used to meet seral stage targets.

5.14 Sensitivity to proposed land-use decisions for the Central Coast Land and Resource Management Plan area

The Central Coast Land and Resource Management Plan (CCLRMP) covers an area of approximately 4.8 million hectares of marine, foreshore and upland area on the west coast of British Columbia. It includes the mainland portions of the Kingcome and Strathcona TSAs, all of the Mid Coast TSA, 8% of the North Coast TSA and portions of several tree farm licences.

On April 4, 2001 the British Columbia Government endorsed Phase 1 of the CCLRMP, termed a Framework Agreement. The agreement included a negotiated map delineating new proposed protection areas (PPAs), option areas, First Nations lead areas and special management zones, described as follows:

- Proposed protection areas (PPAs) — these areas have been generally agreed on as prime candidates for future protection. Some of these areas may also be subject to further discussion for some type of pre-treaty management measures. Accordingly, these areas may be designated in the interim under the *Environment and Land Use Act* until the definition of objectives for protection and management actions are resolved.
- Option areas — these areas contain significant cultural, ecological and economic values, however additional planning is required to determine whether they will be protected or open to activity under ecosystem based management.
- First Nations lead areas — in these areas, forest licensees and environmental non-government organizations have agreed that final recommendations for these areas should be made by First Nations. (None of the First Nations lead areas are located within the Kingcome TSA).
- Special management zones (SMZ) for visual quality — these areas are recognized for their high tourism and recreation values. Management of these areas will seek to accommodate industrial and commercial activities, while maintaining scenic values for tourism and recreational purposes. Visual quality objectives for these areas are to be determined through a collaborative process — specifics of this process have yet to be formalized. Areas within SMZ1 are considered the priority for this subsequent planning; upon their completion similar planning will occur within SMZ2.

5 Timber Supply Sensitivity Analyses

A considerable portion of SMZ1 and SMZ2 areas overlap with the existing 'known' scenic area within the Kingcome TSA and are currently being managed for visual quality as previously described in Section 2.3 and modelled in the base case forecasts.

Ecosystem based management is defined in the agreement as "the management of human activities so that ecosystems, their structure, function, composition and the physical, chemical and biological processes that shaped them, continue at appropriate temporal and spatial scales." The implications of this management approach are unknown.

Table 6 lists the total hectares and per cent timber harvesting land base within each of the Framework Agreement areas in the Kingcome TSA

Table 6. Summary of the Central Coast Land and Resource Management Plan — Framework Agreement area delineated within the Kingcome TSA

CCLRMP — Framework Agreement areas within the Kingcome TSA	Contributing forest area (hectares)	Non-contributing forest area (hectares)	Per cent (%) of timber harvesting land base
Proposed protection area	28 320	4 726	2.8
Option area	5 580	940	0.6
Special management zone (SMZ1)	30 934	13 318	7.9
Special management zone (SMZ2)	69 646	37 370	22.1

Sensitivity analyses were undertaken to examine the timber supply impact of the areas delineated within the Framework Agreement. This involved projections which excluded the PPAs from the timber harvesting land base, with and without the application of visual constraints in the SMZs.

Exclude PPAs from the timber harvesting land base

Most of PPAs within the Kingcome TSA were previously identified as study areas under the Protected Areas Strategy. The exceptions are Swanson Island in the Broughton Archipelago and the upper portions of the Klinaklini River and Wakeman River/Catto Creek watersheds (the latter two areas are currently considered inoperable). A harvest forecast was generated which assumed timber harvesting is excluded from the PPAs. The results are as follows:

- Initial harvest level is 1 279 000 cubic metres per year, 3% lower than in the base case forecast.
- Long-term harvest level is 954 000 cubic metres per hectare, 2.0% below the long-term level of the base case forecast.

Exclude PPAs from the timber harvesting land base and apply visual constraints to special management zones

Approximately 30% of the timber harvesting land base falls within either SMZ1 or SMZ2 areas. As mentioned above, visual management constraints have already been modelled in the base case for those areas where the SMZ overlaps with the 'known' scenic area. A harvest forecast was generated which assumed visual management constraints within the SMZ areas, in addition to the exclusion of PPAs. These constraints were applied only to visible polygons identified in the visual landscape inventory and applied the visual quality classes assigned in the visual landscape inventory. The maximum rates of disturbance for visible areas outside of the 'known' scenic areas but inside the SMZ were assigned to the middle of the recommended ranges. The maximum allowable disturbance rates for 'known' scenic areas were assigned as per the base case. Impacts are illustrated in Figure 25 and are as follows:

- Initial- and mid-term harvest level 1 249 000 cubic metres per year, 5.3% lower than in the base case forecast.
- Long-term harvest level is 953 000 cubic metres per year, 2.1% below the long-term level of the base case forecast.

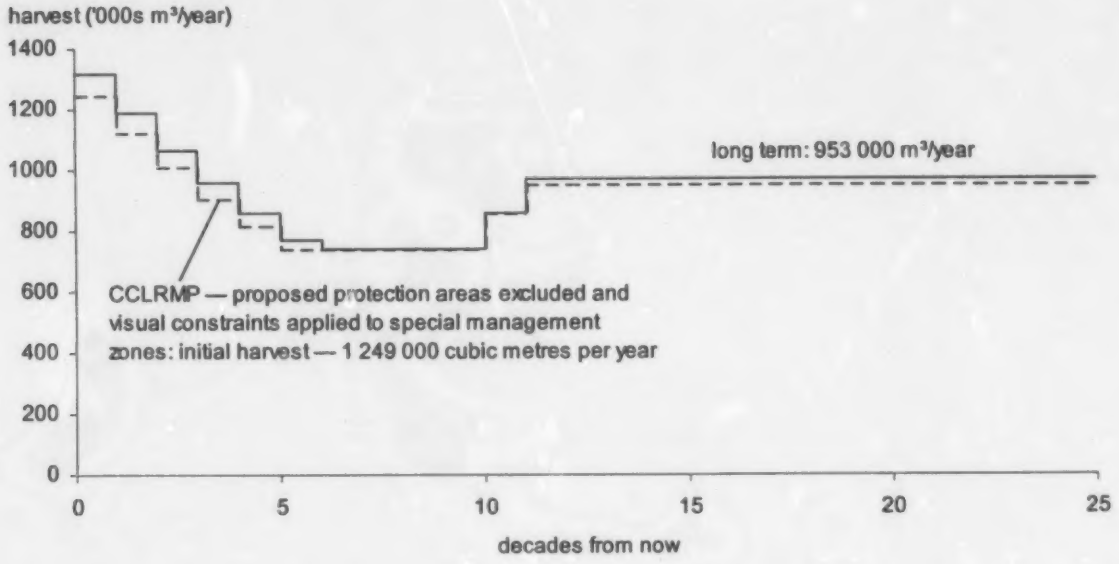

Figure 25. Harvest forecast with PPAs excluded from the timber harvesting land base and visual constraints applied to special management zones — Kingcome TSA, 2001

5 Timber Supply Sensitivity Analyses

5.15 Summary of sensitivity analyses

Table 7 summarizes all sensitivity analyses. Sensitivity analyses showing an increase relative to the base case harvest forecast are indicated with (++) and (+) symbols. Sensitivity analyses showing no impact relative to the base case are left blank. Sensitivity analyses showing a decrease relative to the base case are indicated with (– –) or (-) symbol.

Table 7. Summary of sensitivity analysis — Kingcome TSA, 2001

Report section	Description	Impact of sensitivity analysis relative to base case harvest forecast		
		Short term	Mid term	Long term
5.1	Alternative harvest flows	– –	+ +	
5.2	Green-up ages increased by 5 years	– –		
5.2	Green-up ages decreased by 5 years	+		
5.2	Green-up assumptions based on 5-pass harvest	–		
5.2	Green-up assumptions based on 3-pass harvest	+		
5.3	Apply visual constraints to all visible areas in the VLI	–		
5.4	Maximum visual disturbance set to low-end of the range	– –		–
5.4	Maximum visual disturbance set to high-end of the range	+		+
5.5	10% decrease in timber harvesting land base	– –	– –	– –
5.5	5% decrease in timber harvesting land base	–	–	–
5.5	10% increase in timber harvesting land base	+	+	+
5.5	5% increase in timber harvesting land base	+	+	+
5.6	Increased area of red alder managed			
5.7	Exclusion of low-site forest	–	–	–
5.8	10% decrease in yield estimates for existing stands	– –	– –	
5.8	10% increase in yield estimates for existing stands	+ +	+ +	
5.9	10% decrease in yield estimates for managed stands			– –
5.9	10% increase in yield estimates for managed stands			++
5.10	Volume gains from the use of genetically improved seed			+
5.11	Minimum harvestable ages +/–5 years			
5.12	Increase in productivity estimates for future stands		+ +	+ +
5.13	Application of draft BEO for landscape biodiversity			
5.13	Application of mature-seral cover requirement			
5.13	Application of early-seral cover requirement	–		
5.14	Proposed land-use decisions for the CCLRMP	–		–

6 Summary and Conclusions of the Timber Supply Analysis

The results of this timber supply analysis suggest that, given changes to the timber harvesting land base and to other forest management assumptions since the last AAC determination, the current allowable harvest level in the Kingcome TSA of 1 399 000 cubic metres per year cannot be maintained. Based on current data and management assumptions a harvest level of 1 319 000 cubic metres per year, 5.7% below the current AAC, can be maintained for one decade. This harvest level has three distinct parts: 1) 15 340 cubic metres per year from red alder-leading stands, 2) 95 000 cubic metres per year from low-site cedar-leading stands and 3) 1 208 660 cubic metres per year from coniferous stands other than low-site cedar. The total harvest of 1 319 000 cubic metres can be sustained for a period of one decade if followed by a series of 10% reductions for the first six decades. The lowest level in the forecast is 740 445 cubic metres per year, which is maintained between decade 7 and decade 10. After the 100 years, the harvest level increases by 15% per decade for two decades reaching a steady long-term level of 973 000 cubic metres per year.

The base case results described above reflect current knowledge and information on forest inventory, growth and management. It is consistent with established harvest flow policy around managing the projected decline from current harvest levels to lower future harvest levels. However, many other harvest patterns are possible which to varying degrees affect the total annual harvest that can be achieved in the short term.

There are several significant differences in the data and management assumptions from the previous timber supply analysis. These include a re-inventory that covered most of the TSA using the Vegetation Resource Inventory standard, changes in operability assumptions which excluded many marginally economic stands, and changes in the application of guidelines for managing visual values in the Kingcome TSA. Other differences are the incorporation of stand- and landscape-level biodiversity requirements, increased reserves for riparian areas and different criteria for defining when stands are likely to become merchantable. Together, these factors indicate a smaller but more productive timber harvesting land base than assumed in the previous analysis.

Uncertainty exists about several factors important in defining timber supply. A series of sensitivity analyses showed that these uncertainties affect timber supply in varying degrees. In particular the base case forecast is sensitive to changes in rate-of-harvest constraints, such cutblock adjacency and visual management guidelines and to changes which influence the amount of old-growth volume available for harvest. The uncertainties with the largest potential effects on base case over the short term (next 50 years) are estimates of the size of the timber harvesting land base, existing stand yields, the length of time it takes stands to achieve green-up and the amount of timber harvesting land base that can take be below the green-up height. The uncertainties with the greatest effects on the mid-term and long-term harvest levels are changes in the productivity estimates for old-growth stands, in yield estimates for managed stands and in the size of the timber harvesting land base. As well, results suggest that application of site index adjustments after current old-growth stands are harvested and regenerated has the potential to significantly increase long-term timber supply.

In conclusion, this analysis indicates that harvest levels in the Kingcome TSA should decline from the current level. Based on current inventory, forest productivity estimates and the current management regime, timber harvesting in the Kingcome TSA should immediately be reduced by 5.7% below the current allowable level. Furthermore, additional reductions will be required over the next six decades. The analysis indicates that several factors related to the current forest inventory and management regime could affect timber supply. However, except for the likelihood that site index estimates for old-growth stands underestimate actual productivity, which affects timber supply primarily over the long term, there is no conclusive evidence to suggest that significant inaccuracies exist in the information used. Nevertheless, uncertainties in the size of the timber harvesting land base, in yield estimates of existing stands, and in the rate-of-harvest that can be achieved while meeting cutblock adjacency and visual management guidelines, result in uncertainty in the timber supply forecasts.

7 Socio-Economic Analysis

The impact of timber supply adjustments on local communities and the provincial economy is an important consideration in the timber supply review. The socio-economic analysis compares the level of forestry activity currently supported by timber harvested from the Kingcome TSA with the level of activity that the TSA could support as the timber supply moves towards its long-term harvest level.

The socio-economic analysis examines harvest levels as projected in the base case and is not intended to examine alternative management scenarios.

The socio-economic analysis consists of the following:

- a profile of the current socio-economic setting;
- a description of the Kingcome TSA forest industry; and
- an analysis of the socio-economic implications of the base case harvest forecast.

7.1 Current socio-economic setting

7.1.1 Current population and demographic trends

The Kingcome TSA is part of the Port McNeill Forest District, which also consists of Tree Farm Licences (TFLs) 6 and 37, and portions of TFLs 39, 43, 45 and 47. In 2000, the population of the Port McNeill Forest District was estimated to be 14,495 people.[1] The largest community in the forest district is Port Hardy with a population of 5,228 people in 2000. Port McNeill is the next largest community with a population of 3,081 people. The other communities for which population data are available are Port Alice and Alert Bay with populations in 2000 of 1,248 and 556, respectively.

The population of the forest district declined marginally between 1996 and 2000, with reductions occurring in Port Hardy, Port Alice and Alert Bay. Population projections indicate, however, that the population is expected to increase through 2005.[2]

(1) B.C. Stats, Population Section, B.C. Ministry of Finance and Corporate Relations. Estimate for 2000 based on population growth rates in the Mount Waddington Regional District.

(2) B.C. Stats, Population Section.

7 Socio-Economic Analysis

Table 8 shows population levels for the Port McNeill Forest District, the Mount Waddington Regional District and communities where population statistics are available.

Table 8. Port McNeill Forest District population statistics, 1991–2005

	1991	1996	2000	2005[a]	% change 1996-2000
Port Hardy	5,229	5,512	5,228	N/A	–5.2
Port McNeill	2,718	3,052	3,081	N/A	0.1
Port Alice	1,412	1,387	1,248	N/A	–10.0
Alert Bay	644	638	556	N/A	–12.8
Mount Waddington Regional District	14,293	15,224	15,203	15,341	–0.1
Port McNeill Forest District	13,832	14,532	14,495	14,720	–0.5
British Columbia	3,282,910	3,882,043	4,063,760	4,372,208	4.7

(a) Estimate only.
Source: Census of Canada 1991, 1996. 2000 estimates and 2005 projections from B.C. Statistics Population Section.
www.bcstats.gov.bc.ca/data/pop/popstart.htm
N/A = not available.

7.1.2 Economic profile

From 1991 to 1996, the total experienced labour force in the Port McNeill Forest District declined by 14% to 8,265 from 9,640.[3] In comparison, the provincial experienced labour force increased by 14% over the same period. The unemployment rate in the Port McNeill Forest District was 10.9% in 1996 compared with 13.6% in 1991. Where data are available, labour force activity since 1996 and differences in dependency within the district will be discussed in more detail below.

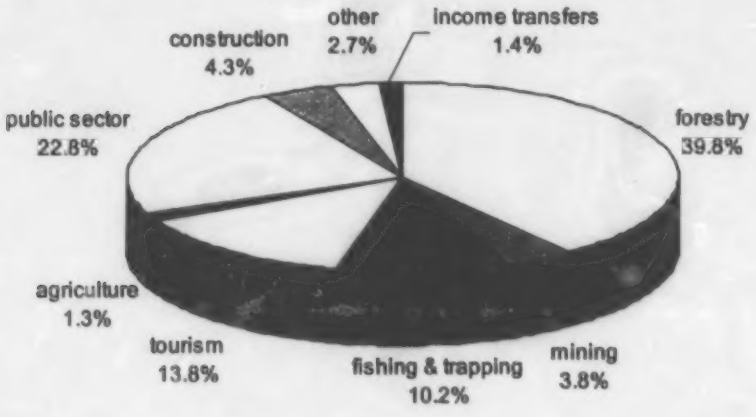

Figure 26. Port McNeill Forest District experienced labour force by sector, 1996.

Source: B.C. Ministry of Finance and Corporate Relations. 1999. The 1996 forest district tables.

In 1996, the forestry sector supported the largest percentage of the workforce in the Port McNeill Forest District. Statistics from 1996 indicate that the forestry sector, which includes harvesting, silviculture and forest products manufacturing, supported about 40% of the total (direct, indirect and induced) labour force and was the source of 47% of the income flowing into the region. Census data, excluding Sointula, Alert Bay and the mainland portion of the forest district, indicate that the forestry sector on the Vancouver Island portion of the TSA accounted for 51% of income.[4] This is the highest dependency figure for any of the local areas in the province (local areas as defined in the cited document).

(3) Census of Canada, 1991, 1996.

(4) B.C. Stats. 1999. British Columbia local area economic dependencies and impact ratios – 1996. Victoria: B.C. B.C. Ministry of Finance and Corporate Relations. The Port Hardy local area includes the communities of Coal Harbour, Holberg, Hyde Creek, Mahatta River, Port Alice, Port Hardy, Port McNeill, Telegraph Cove, Winter Harbour and Woss Lake.

From 1996 to 2000, the forest products manufacturing sector remained relatively constant employing around 600 to 625 people. Data are not available for changes in logging and forestry services employment since 1996, but declines in this subsector are likely given the 22% reduction (399 000 cubic metres) in the AAC of the Kingcome TSA in 1996. The exact change to the labour force will not be fully understood until the Census figures from 2001 are available.

The public sector is the second largest employer in the Port McNeill Forest District and consists of municipal, provincial and federal government employment, including education and health services. In 1996, the public sector supported 23% of the labour force and 18% of the region's income. The public sector accounts for, on average, 23% of employment in forest districts across the province.

The tourism sector in Figure 26 includes both business and leisure travel. This sector supported 14% of the total labour force and accounted for about 7% of the total income flowing into the region. The difference between the percentage employed and income reflects the level of wages earned by the average tourism and service sector worker and the magnitude of business-related supply and service spending. The tourism sector includes accommodation, food and beverages, and a portion of the retail and personal services trades.

Until the closure of BHP Minerals (Canada) Ltd.'s Island Copper Mine, mining played a significant role in the economy of Port Hardy. The mine closed at the end of 1995 and reclamation work began thereafter. At the time of closure the mill employed about 450 people.[5] More recent dependency figures would show a decline in mining's role in the economy, likely increasing the contribution of other sectors.

The fishing and trapping sector of the district employed 10% of the total labour force and accounted for about 7% of the income. The Alert Bay local area, however, which includes Alert Bay, Sointula and the mainland portion of the forest district relied on the fishery for 19% of its income and has a higher dependency on the fishing industry than on the forest industry. The fisheries sector has undergone a number of changes in recent years, including the federal government's licence buyback program. The traditional fishing industry appears to be declining; however, in its place the farmed salmon industry is expanding. Regardless, employment in the fishery peaked in 1991 and by 1996 had declined by 35%.

Investment income, pensions and other transfer-related income (employment insurance and other social assistance payments, for example) are becoming a more important source of income for many areas of the province. In the Port McNeill Forest District, transfer income is the source of 11% of the income flowing into the area and supports about 1-2% of induced employment (as indicated in Figure 26). On Vancouver Island, the Parksville-Qualicum area has the highest reliance on investment, pension and other transfer income where in 1996 it accounted for 46% of the income flows.

The remaining employment in the Port McNeill Forest District is supported by construction employment not allocated to one of the major sectors, agriculture, and other transportation and manufacturing activities not associated with the major sectors.

(5) B.C. Ministry of Energy and Mines. www.gov.bc.ca/em/

The indirect and induced employment included in Figure 26 reflects the income spent by companies and employees and the number of jobs that depend on those expenditures. Employment multipliers illustrate this spending effect: a larger multiplier indicates that each job of a particular sector will support more business activity at supply and service companies, due to higher company revenues, supply requirements and wages (Table 9). For example, 1996 multiplier estimates indicate that every 100 full-time direct forestry jobs in the Port McNeill Forest District support an additional 31-64 indirect and induced full-time jobs, depending on the forestry activity (harvesting or processing). In comparison, every 100 full-time direct jobs in the tourism and business travel sector support an estimated 12 indirect and induced jobs* and every 100 jobs in the public sector support an additional 18 indirect and induced jobs. The differences between sectors are due to the spending patterns by sector businesses and their employees. The multipliers indicate how a change to a particular sector could affect the broader economy.

Table 9. Employment multipliers, by sector, for the Port McNeill Forest District, 1996

Basic sector*	Employment multiplier
Forestry: logging and manufacturing	1.31–1.64
Agriculture and food	1.24
Tourism	1.12
Public sector	1.18
Mining	1.60
Construction	1.33

Source: B.C. Ministry of Finance and Corporate Relations. 1999. The 1996 forest district tables.

Indirect and induced jobs
Indirect jobs are supported by direct business purchases of goods and services. Induced jobs are supported by employee purchases of goods and services; for example, at retail outlets.

Basic sector
Sectors of the economy, such as forestry, tourism and mining, that create flows of income into the region and are assumed to be drivers of the local economy. Non-basic sectors, such as retail outlets, are supported by basic sectors.

7.2 Kingcome TSA forest industry

7.2.1 Current allowable annual cut

The current (effective November 1996) allowable annual cut (AAC) for the Kingcome TSA is 1 399 000 cubic metres. Table 10 provides a breakdown of the AAC by tenure type. Before the current level, the AAC was 1 798 270 cubic metres.

Table 10. Kingcome TSA allowable annual cut, by licence type

	AAC (cubic metres)	Per cent (%) of total AAC
Forest licences — replaceable	986 689	70.5
Forest licences, non-replaceable	111 382	8.0
Small Business Forest Enterprise Program (SBFEP)	270 430	19.3
Timber sale licences > = 10 000 m^3	10 009	0.7
Woodlot licence*	6 500	0.5
Forest Service Reserve	13 990	1.0
Total	1 399 000	100.0

Source: Ministry of Forests.

7.2.2 Kingcome TSA harvest history

Table 11 summarizes the volume of timber harvested in the Kingcome TSA from 1993 to 2000. The actual volume of timber harvested is an important indicator of forestry activity in the TSA. While the AAC is the maximum allowable annual harvest level, the actual volume of timber harvested in a particular year directly relates to the level of economic activity. Differences in annual harvest levels are facilitated provisions for cut control[6] variations that allow licensees to vary their harvests based on operating and market conditions. If actual annual harvest levels are consistently less than the AAC, then forestry activity is below its full potential.[7]

(6) Cut control allows licensees to vary the volume between annual harvest and AAC by ± 50% per year, and by ± 10% over a 5-year cut control period.

(7) Full potential referred to here is based on the allocated volumes of the AAC, and is not necessarily the same as full economic potential which is based on the international market for wood products.

Woodlot licence
An agreement entered into under the Forest Act. *It allows for small-scale forestry to be practised in a described area (Crown and private) on a sustained yield basis.*

7 Socio-Economic Analysis

In 2000, 1 321 749 cubic metres were harvested from the Kingcome TSA (see Table 11). During the 1993 to 1997 cut control period, there was an undercut of approximately 15%. The latest cut control period runs from 1998 to 2002.

Table 11. Kingcome TSA volumes billed, by licence type, 1993–2000

	Cubic metres (m^3)							
Tenure	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Forest licences (FL)	1 068 103	1 276 475	1 521 240	1 342 265	903 628	840 682	915 230	1 040 357
Small Business Forest Enterprise Program (SBFEP)	254 077	98 110	236 659	217 151	342 201	191 966	83 134	274 432
Timber Sale Licence(TSL)	0	0	0	6 740	14 173	0	0	6 960
Other[a]	1 075	4 138	19 972	5 918	3 671	307	117	0
Total	1 323 255	1 378 723	1 777 871	1 572 074	1 263 673	1 032 955	998 481	1 321 749
Allowable annual cut (AAC)[b]	1 798 270	1 798 270	1 798 270	1 798 270	1 399 000	1 399 000	1 399 000	1 399 000
Average harvest 1993–1997:	1 463 119							
Average harvest 1998–2000:	1 117 728							

(a) "Other" consists of cutting permits such as rights-of-way, road permits, and other small temporary permits.

(b) The AAC was reduced to 1 399 000 cubic metres effective November 1, 1996.

Source: Ministry of Forests.

7.2.3 Kingcome TSA major licensees and processing facilities

International Forest Products Ltd.

International Forest Products Ltd. (Interfor) has a replaceable forest licence in the Kingcome TSA to harvest 727 944 cubic metres of timber per year. In 2000, Interfor harvested 577 152 cubic metres under its Kingcome TSA licence. Table 12 outlines Interfor's recent harvest activity and 1998–2000 average employment levels associated with its Kingcome TSA operations.

Table 12. Interfor volumes billed and provincial employment statistics

Allowable annual cut (AAC)	727 944 cubic metres
2000 harvest	577 152 cubic metres
1998 – 2000 average volumes billed	556 622 cubic metres
Employment[a] (1998-2000 person-years)	
Harvesting, silviculture	230
Processing	400
Total	630

(a) The employment figures relate to the 1998-2000 average volume of 556 622 cubic metres harvested from the Kingcome TSA only and processed in British Columbia.

Interfor currently operates six lumber mills in the province, none of which are located in the Kingcome TSA. Five of Interfor's mills are located in the Squamish-Vancouver area and one is located at Adams Lake, east of Kamloops. From 1998 to 2000, the sawmills processed an average of about 2.6 million cubic metres per year. In April, 2001, Interfor announced that by the end of October, 2001, it will close its Fraser Mills facility in Coquitlam, reducing the number of lumber mills Interfor operates in the Lower Mainland to three. The Kingcome TSA represents approximately 20-25% of Interfor's total mill consumption.

7 Socio-Economic Analysis

Western Forest Products Limited

Western Forest Products Limited (Western), a Doman Industries Ltd. company, has a replaceable forest licence in the Kingcome TSA to harvest 83 981 cubic metres of timber per year. In 2000, Western harvested 99 646 cubic metres under its Kingcome TSA licence. Table 13 outlines Western's recent harvest activity and 1998–2000 average employment levels associated with its Kingcome TSA operations.

Table 13. Western volumes billed and provincial employment statistics

Allowable annual cut (AAC)	83 981 cubic metres
2000 harvest	99 646 cubic metres
1998 – 2000 average volumes billed	67 055 cubic metres
Employment[a] (1998-2000 person-years)	
Harvesting, silviculture	16
Processing	48
Total	64

(a) The employment figures relate to the 1998-2000 average volume of 67 055 cubic metres harvested from the Kingcome TSA only and processed in British Columbia.

Doman operates nine sawmills, a chip mill and two pulp mills. Doman operates the Port Alice pulp mill, which receives some of its timber supply from the Kingcome licence. From 1998 to 2000, the solid wood mills processed an average of close to 3.6 million cubic metres of timber per year. The TSA represents approximately 2% of Doman's timber supply requirements.

Mill and Timber Products Ltd.

Mill and Timber Products Ltd. (Mill and Timber) has a replaceable forest licence in the Kingcome TSA to harvest 53 710 cubic metres per year and a non-replaceable forest licence to harvest a further 86 382 cubic metres per year. In 2000, Mill and Timber harvested 167 866 cubic metres. Table 14 outlines Mill and Timber's recent harvest activity and 1998–2000 average employment levels associated with its Kingcome TSA operations.

Table 14. Mill and Timber volumes billed and provincial employment statistics

Allowable annual cut (AAC)	140 092 cubic metres
2000 harvest	167 866 cubic metres
1998 – 2000 average volumes billed	139 258 cubic metres
Employment[a] (1998-2000 person-years)	
Harvesting, silviculture	116
Processing	100
Total	216

(a) The employment figures relate to the 1998–2000 average volume of 139 258 cubic metres harvested from the Kingcome TSA only and processed in British Columbia.

Mill and Timber operates a sawmill in the Lower Mainland and Shushartie Log Sales Ltd. pole and post mill in Port Hardy. The Vancouver mill processes lumber and has the capacity to produce approximately 60–65 million board feet per year. The Port Hardy mill has the capacity to produce approximately 40,000 pieces. From 1998 to 2000, about 36% of the Kingcome harvest was processed at Mill and Timber mills. The remainder either stayed in the TSA for processing at other local mills, or was shipped to other Lower Mainland mills.

7 Socio-Economic Analysis

Weyerhaeuser Company Ltd.

Weyerhaeuser Company Ltd. (Weyerhaeuser) has a replaceable forest licence in the Kingcome TSA to harvest 63 363 cubic metres per year. Northwest Hardwoods, owned by Weyerhaeuser, has a non-replaceable forest licence to harvest 15 425 cubic metres per year of deciduous trees, namely alder. In 2000, Weyerhaeuser and Northwest harvested 52 445 cubic metres under the Kingcome TSA licences. Table 15 outlines Weyerhaeuser's recent harvest activity and 1998-2000 average employment levels associated with its Kingcome TSA operations.

Table 15. Weyerhaeuser volumes billed and provincial employment statistics

Allowable annual cut (AAC)	
Weyerhaeuser	63 363 cubic metres
Northwest	15 425 cubic metres
2000 harvest	
Weyerhaeuser	40 760 cubic metres
Northwest	11 685 cubic metres
1998 – 2000 average volumes billed	
Weyerhaeuser	41 645 cubic metres
Northwest	11 040 cubic metres
Employment[a] (1998-2000 person-years)	
Harvesting, silviculture	18
Processing	37
Total	55

(a) The employment figures relate to the 1998–2000 average volume of 52 445 cubic metres harvested from the Kingcome TSA only and processed in British Columbia.

In 2000, Weyerhaeuser operated 11 lumber mills, located in the Vancouver and Kamloops Forest Regions, one pulp mill located in Kamloops and a panel mill in Vancouver. From 1998 to 2000, Weyerhaeuser solid wood mills processed an average of close to 5 million cubic metres of timber, about 3 million cubic metres of which are processed at coastal mills. The Kingcome TSA represents about 2% of the coastal total.

Richmond Plywood Corporation

Richmond Plywood Corporation (Richmond Plywood) has a replaceable forest licence in the Kingcome TSA to harvest 53 773 cubic metres per year. In 2000, Richmond Plywood harvested 59 429 cubic metres under its Kingcome TSA licence. Table 16 outlines Richmond Plywood's recent harvest activity and 1998-2000 average employment levels associated with its Kingcome TSA operations. Richmond Plywood operates a veneer and plywood plant in Richmond. Timber from the Kingcome TSA would be used in the mill, or sold or traded for the appropriate log types.

Table 16. Richmond Plywood volumes billed and provincial employment statistics

Allowable annual cut (AAC)	53 773 cubic metres
2000 harvest	59 429 cubic metres
1998 – 2000 average volumes billed	56 010 cubic metres
Employment[a] (1998-2000 person-years)	
Harvesting, silviculture	25
Processing	40
Total	65

(a) The employment figures are estimates only and relate to the 1998–2000 average volume of 56 010 cubic metres harvested from the Kingcome TSA only and processed in British Columbia.

Other licensees

Other non-Small Business Forest Enterprise Program (SBFEP) licensees in the TSA include Scott Paper Ltd., Probyn Log Ltd. and 442578 B.C. Ltd. The combined AAC for these companies is 14 942 cubic metres per year. The Scott Paper licence, is restricted to deciduous volumes.

The remainder of the Kingcome TSA timber supply is harvested under the SBFEP. The total AAC apportioned to the SBFEP is 270 430 cubic metres. In 2000, the total volume harvested under the SBFEP was 274 432 cubic metres. From 1998 to 2000, the annual SBFEP harvest averaged 183 177 cubic metres.

Processing facilities

The Port McNeill Forest District is dominated by small- to medium-sized solid wood operations. The district is home to 11 small lumber mills, four shake and shingle mills and one pole mill. Doman Industries Port Alice pulp mill is located just outside the Kingcome TSA but within the Port McNeill Forest District. From 1998 to 2000, the solid wood mills processed an average of about 110 000 cubic metres of timber per year. Sources of timber for these mills include the forest licence majors and the SBFEP, plus private lands and tree farm licences.

Two local mills, Lukwa Mills Ltd. and S&L MFG Ltd., responded to a survey. Both mills rely on the TSA for a portion of their timber, notably Lukwa Mills, which from 1998 to 2000 obtained about 90% of its timber supply from the TSA.

7.2.4 Forestry sector employment and employment coefficients

The preceding harvesting and employment information is used to develop employment coefficients, which are used to project future employment levels in the forestry sector. For this purpose, the forestry sector has been divided into three subsectors:

- harvesting and other woodlands-related employment including falling, log salvage, log scaling, log transport, harvest planning and administration (road building and maintenance are included in indirect employment estimates);
- silviculture employment such as planting, surveying and other basic and intensive silviculture activities, such as spacing, fertilization and pruning*; and
- primary timber processing employment at lumber mills, veneer and plywood mills, shake and shingle mills, chip mills, log home mills and pulp and paper mills.

Harvesting and silviculture employment

The harvesting subsector of the forest industry includes both company and contract loggers and is the first subsector that would be affected by a change in the AAC. The predominant silvicultural system used in the Kingcome TSA is clearcutting using ground-based, cable and helicopter yarding systems. The active logging season can run all year, but varies by company and weather conditions. Local residents account for an average of about 40% of the harvesting workforce, but this can vary substantially by company.

The silviculture subsector is perhaps the least tied to the current level of harvest, given that silviculture activities are ongoing for as much as 10-15 years following harvesting. However, certain activities such as planting are obviously more closely tied to recent harvest levels. Basic silviculture consists of pre- and post-harvest surveys, site preparation, planting, brushing, cone collecting and some spacing. Enhanced, or intensive, silviculture includes spacing, fertilization and pruning. In the TSA, major licensees are responsible for basic silviculture on areas harvested under major licences. The provincial government is responsible for the remaining basic and all enhanced silviculture on Crown land, which is completed by silviculture contractors.

Employment data compiled for this timber supply review indicate that, from 1998 to 2000, the average TSA harvest of about 1.1 million cubic metres per year supported about 559 person-years annually of direct harvesting and silviculture employment across the province. About 23% of this workforce resides within the Kingcome TSA.

Pruning
The manual removal of the lower branches of crop trees to a predetermined height to produce clear, knot-free wood.

Processing employment

The Kingcome TSA has a small processing sector that from 1998 to 2000 processed an average of about 110 000 cubic metres. The timber processed at local solid wood mills comes mainly from the Port McNeill Forest District. The Port Alice pulp mill relies on the Port McNeill and other coastal forest districts for its timber supply.

Employment data compiled for this timber supply review indicate that, from 1998 to 2000, the TSA harvest of about 1.1 million cubic metres per year supported approximately 805 person-years (three-year average) of direct processing employment across the province. About 15% of this processing employment is associated with operations within the Kingcome TSA.

Forest Service employment

The Port McNeill Forest District office located in Port McNeill administers the Kingcome TSA. Currently, about 82 people work in the forest district office. Forest Service staff are involved in review and approval of licensee plans, administration and enforcement of the *Forest Practices Code* and related regulations, and SBFEP-related planning for the Kingcome TSA.

Kingcome TSA employment coefficients

Table 17 summarizes the employment supported by the 1998–2000 average harvest in the Kingcome TSA and the corresponding employment coefficients. These coefficients have been calculated for the TSA and province to highlight the level of forestry activity within the Kingcome TSA and to identify the contribution that the Kingcome TSA's forestry sector makes to the provincial economy. The two employment levels are defined as follows:

- TSA employment and employment coefficients, which comprise residents of the Kingcome TSA who are employed in the forestry sector within the Kingcome TSA and who rely on the Kingcome TSA timber supply; and
- Provincial employment and employment coefficients, which comprise all forestry sector employment in the province that relies on the Kingcome TSA timber supply, including both residents of the Kingcome TSA and those who live elsewhere.

Employment is divided into direct, indirect and induced components; the sum of the components is the total impact. The coefficients are expressed as the number of full-time jobs, or person-years, per 1000 cubic metres of timber harvested. Indirect and induced employment figures were derived using employment multipliers developed by the Ministry of Finance.

More detailed information regarding employment coefficients and multipliers is presented in Appendix B, "Socio-Economic Analysis Background Information."

7 Socio-Economic Analysis

Table 17. Kingcome TSA employment and employment coefficients[8], average 1998–2000

Forest industry activity	TSA employment (person-years)	TSA coefficients (person-years/ '000s m³)	Provincial employment (person-years)	Provincial coefficients (person-years/ '000s m³)
Harvesting	168	0.15	503	0.45
Silviculture	22	0.02	56	0.05
Processing	123	0.11	805	0.72
Total direct	313	0.28	1,364	1.22
Indirect + induced	201	0.18	1,654	1.48
Total employment	514	0.46	3,018	2.70

Note: Employment estimates are reported in person-years based on average 1998–2000 employment levels and the average 1998–2000 Kingcome TSA harvest of 1 117 728 cubic metres per year.

7.2.5 Kingcome TSA employment income

From 1998 to 2000, the average income for forestry sector employees associated with the Kingcome TSA was about $47,125, based on average provincial income levels for logging and forestry services, solid wood manufacturing and pulp and paper manufacturing (see Appendix B). Average income for indirect and induced sector employees was $30,800. The total direct income associated with the forestry sector in the Kingcome TSA averaged $64.3 million per year and total income for indirect and induced employment averaged $50.9 million per year (incomes are reported in 1999 dollar values). Combined, total employment income in the Kingcome TSA averaged $115.2 million per year. Table 18 shows income levels, average wages and salaries, and total income per 1000 cubic metres of harvested timber.

Table 18. Average direct and indirect and induced incomes and total employment income, 1998–2000

	Average wage (1998 dollar value)	Total income ($ millions)	Total income ($/'000s m³)
Direct	47,125	64.3	57,508
Indirect + induced	30,800	50.9	45,577
Total income		115.2	103,085

Source: Statistics Canada. Annual estimates of employment, earnings and hours. Catalogue # 10-3009XKB

Statistics Canada. Labour Force Survey, Average weekly wage rate.

(8) Other employment coefficients may be found in other documents for the same or similar areas. A difference in ratios can occur for several reasons, such as using different sources of employment data and rounding of estimates, dividing employment by a different harvest level, using a different definition of a full-time position and changing the definition of forestry subsectors. However, the size of impacts associated with a timber supply change should illustrate similar effects.

7.2.6 Provincial government revenues

The provincial government receives various taxes and other revenues from the forest industry. The forest industry pays stumpage and rents to the provincial government for the rights to timber and its use, and pays other industry operating taxes such as corporate income, property and sales taxes. The provincial and federal governments also receive revenues from forestry employees directly through income taxes.

From 1998 to 2000, forest industry activity in the Kingcome TSA provided an average of about $31 million in annual stumpage and rent payments to the provincial government. Other government revenues from forest industry taxes accounted for $10.1 million per year. Total employment supported by the Kingcome TSA harvest generated total annual provincial and federal income taxes worth $25.3 million. About one-third of the total income tax, or $8.4 million per year, goes to the provincial government. Table 19 shows average annual provincial government revenues for 1998–2000.

Table 19. Average annual provincial government revenues, 1998–2000

	Average annual revenue 1998–2000 ($1999 millions)	Average revenue ($/'000s m^3)
Stumpage/rent	31.0	27,730
Industry taxes	10.1	9,037
Provincial income tax	8.4	7,531
Total provincial government revenues	49.5	44,298

Sources: Ministry of Forests, Revenue Branch; PricewaterhouseCoopers; Revenue Canada.

7.3 Socio-economic implications of the base case harvest forecast

The socio-economic analysis focuses on harvest level changes in the short- to mid-term of 10-30 years from now and considers:

- the implications of alternative harvest levels for both the Kingcome TSA and the province;
- possible impacts on communities within the TSA;
- timber requirements of processing facilities within the Kingcome TSA; and
- regional timber supply implications.

The socio-economic analysis considers average levels of forest industry related activity that the base case harvest forecast could support. Impacts associated with future harvest levels are calculated using employment, income and revenue coefficients (per 1000 cubic metres). This method assumes that the current role of the forest industry in the provincial econ my and labour productivity will not change. For example, employment levels in the future can be predicted based on today's relationship between employment and the volume of timber harvested and processed. The analysis also assumes that the proportions of harvesting, silviculture and timber processing employment will remain constant and that the types and proportions of wood products manufactured will remain the same.

While this method is reasonably accurate for short-term forecasts (within the next five years), employment coefficients 20 years from now may differ greatly due to changes in market conditions, timber processing technologies, etc. The analysis indicates the magnitude of impacts to employment, employment income and provincial government revenues, within a constantly changing socio-economic environment.

7.3.1 Short- and long-term implications of alternative harvest levels

Employment and income impacts in the Kingcome TSA

Kingcome TSA employment and income impacts focus on those workers who are supported by the TSA harvest and who reside within the TSA. Workers who come to the TSA to work but who reside outside the TSA are included in the provincial impact section, as are those supported by Kingcome TSA timber processed at mills outside the forest district. Table 20 indicates the employment and income that the current AAC could support if fully harvested and processed.

The current AAC of 1 399 000 cubic metres, if fully harvested, can support about 392 person-years of direct employment and a further 252 person-years of indirect and induced employment within the TSA. This level of employment would result in about $26.3 million in annual total employment income.

From 1998 to 2000, the average annual harvest level was 1 117 728 cubic metres. Over the previous cut control period, the harvest level was approximately 15% below the AAC. As such, the Kingcome TSA AAC is likely not at its full employment potential. Based on the survey undertaken for this timber supply review and information from other statistical sources (see Appendix B), employment currently supported by the TSA average harvest of 1 117 728 cubic metres is about 315 person-years of direct employment and 200 person-years of indirect and induced employment. Fully harvesting the TSA AAC would increase the average harvest level by about 280 000 cubic metres per year and would have an effect on the workforce by either lengthening the work year or increasing the number employed.

7 Socio-Economic Analysis

The timber supply forecast indicates a decline in the timber supply over the next several decades. In the first decade the timber supply will decline to about 1.319 million cubic metres per year. This is a reduction of 80 000 cubic metres from the current AAC, which is a sufficient volume of timber to support about 25 person-years of direct forest sector employment within the TSA. Reducing employment by this amount could also mean a reduction in the TSA's annual income of roughly 1.5 million dollars, if no other sources of income were found for those displaced workers.

Further reductions in the timber supply are forecast to occur for several decades. This trend will add to the timber processing over-capacity situation currently existing in the Vancouver Forest Region. By decade 3, the timber supply is forecast to decline to a level similar to the current annual average harvest of 1.1 million cubic metres, with further declines beyond.

Provincial employment and income impacts

Provincial employment and income impacts include all the activity supported by the Kingcome TSA harvest, regardless of processing location and place of residence.

The current AAC of 1 399 000 cubic metres can support about 1,707 person-years of direct employment and a further 2,070 person-years of indirect and induced employment across the province. This level of employment could support $144.2 million in annual total provincial employment income.

The 80 000 cubic metre decline in the timber supply forecast in decade one is enough volume to support about 215 person-years of direct, indirect and induced employment across the province. Other industry and sources of income would have to replace the expenditures of the forest industry in order to maintain the level of indirect and induced employment.

Given recent harvest trends, employment may have already adjusted to harvest rates below the current AAC. If so, the employment impacts modelled in this analysis may have already occurred. As the timber supply declines further over the next several decades companies will again be forced to adjust their workforce.

7 Socio-Economic Analysis

Table 20. Kingcome TSA socio-economic impacts: base case harvest forecast

	Current AAC	Current harvest rate	Base case (first decade)
Harvest level (1998-1999 average)	N/A	1 117 728	N/A
Timber supply	1 399 000	1 399 000	1 319 000
Difference from current AAC		(281 272)	(80 000)
Kingcome TSA			
Employment		**(person-years)**	
Direct	392	313	369
Indirect + induced	252	201	237
Total	644	514	606
Range[a] of employment gain (loss)		(111-130)	(32-38)
Employment income		**($1999 million per year)**	
Direct	18.5	14.7	17.4
Indirect + induced	7.8	6.2	7.3
Total	26.3	20.9	24.7
Range of income gain (loss)		(4.6-5.4)	(1.4-1.6)
Province[b]			
Employment		**(person-years)**	
Direct	1,707	1,364	1609
Indirect + induced	2,071	1,654	1952
Total	3,777	3,018	3,561
Range of employment gain (loss)		(638-759)	(180-216)
Employment income		**($1999 million per year)**	
Direct	80.4	64.3	75.8
Indirect + Induced	63.8	50.9	60.1
Total	144.2	115.2	135.9
Range of income gain (loss)		(24.4-29.0)	(7.0-8.3)
Provincial government revenues		**($1999 million per year)**	
Stumpage and related payments	38.8	31.0	36.6
Forest industry taxes	12.6	10.1	11.9
Employee income taxes	10.5	8.4	9.9
Total	61.9	49.5	58.4
Gain (reduction) in revenues		(12.4)	(3.5)

(a) Gains or losses are based on the difference between the current average harvest. The ranges for employment and income changes consider employment insurance and other social assistance programs that give temporary short-term income to unemployed or displaced workers. The range's upper limit assumes that all those who are unemployed or displaced will leave the TSA to seek opportunities elsewhere and will no longer spend their income locally, thus imparting a higher impact on the local economy than if they had not left. The range's lower limit assumes that employment insurance and other social assistance payments to unemployed or displaced workers will temporarily encourage them not to leave the community, thus reducing the induced impacts of a lower harvest level. The actual impacts of changes in harvest levels on employment and incomes will likely fall within the specified ranges. More details are in Appendix B.

(b) TSA employment and income estimates are included in the provincial employment and income estimates.

Provincial government revenue impacts

Provincial government revenues from the forest industry include stumpage, royalties and rent payments; other taxes such as logging, corporate income, sales, property and electricity taxes; and income taxes from direct, indirect and induced employees. Under the existing tax and stumpage regimes, the current AAC of 1 399 000 cubic metres, if fully harvested, would provide on average about $61.9 million annually to the provincial government. The 1998-2000 average harvest rate of 1.1 million cubic metres generated an average of $49.5 million in government revenues per year.

7.3.2 Community-level impacts

The impacts related to changes in the timber supply can affect the socio-economic environment of a community. A reduction in employment and income could affect various socio-economic conditions in communities: for example, population growth rates, the size of the labour force, economic development opportunities and government-funded services. These changes would have a greater effect on an economy dependent on a single industry than on one that is more diversified and experiencing growth in other sectors.

Port McNeill has a number of challenges in its future growth. Declines in the industrial sectors of forestry, mining and fishing in the last ten years have affected traditional sources of employment and income and future growth in these sectors may be difficult given the more remoteness of the area and timber supply pressures felt across the Vancouver Forest Region. Tourism and fish farming are bright spots for future development; however, they too have limited development potential. Taking advantage of opportunities based on non-timber forest products and services may also provide future benefits for local communities. Forecast declines in the timber supply will impact local communities and the income spent at local businesses, adding further challenges to an already impacted area.

7.3.3 Nature, production capabilities and timber requirements of processing facilities

The current milling structure of the Kingcome TSA consists of about 16 small to medium solid wood mills. The Port Alice pulp mill is located just outside the TSA but within the Port McNeill Forest District. From 1998 to 2000, the average annual volume of logs processed by local mills was about 110 000 cubic metres. The Port Alice pulp mill relies on timber from a number of sources, of which the TSA is a relatively minor one.

The current mill consumption is about 10% of the volume of timber cut in the Kingcome TSA. Processors state that they could increase production and employment at local mills if they had better access to local timber supplies.

7.3.4 Regional timber supply issues

The regional timber supply is an important consideration when examining potential future impacts associated with timber supply changes. The Vancouver Forest Region supplies timber to mills throughout the southwestern portion of the province. From 1998 to 2000, solid wood mills in the Vancouver Forest Region processed an average of 17.5 million cubic metres of timber per year. Timber from the Kingcome TSA accounts for about 7-8% of the region's consumption.

Over the next 25 years, timber supply forecasts indicate that the average annual harvest in the Vancouver Forest Region could decline by up to 20%, or 4 million cubic metres.[9] Given a change of this size, the current processing structure of southwestern British Columbia could not be maintained. The Kingcome TSA timber supply is forecast to decline and will contribute to the fibre supply pressure being felt throughout the Vancouver Forest Region.

(9) This reduction is based on moving from the current Vancouver Forest Region timber supply of about 20 million cubic metres per year to 16 million cubic metres.

7 Socio-Economic Analysis

7.4 Summary

The forest industry in the Kingcome TSA is the leading source of employment and income for local residents. The public sector is the second largest employer in the TSA, but is dependent on the population and service requirement levels of the community, as such is also tied to the health of other sectors.

The average harvest from 1998 to 2000 was 1 117 728 cubic metres per year. This level is about 20% below the current AAC. This harvest level supports on average about 1,360 person-years of direct employment and a further 1,650 person-years of indirect and induced employment across the province.

The current AAC of 1 399 000 cubic metres, if fully harvested and processed, can support about 1,700 person-years of direct forestry employment and a further 2,070 person-years of indirect and induced employment across the province.

Residents of the Kingcome TSA account for about 23% of the direct employment. The employment income associated with this direct, indirect and induced employment would be about $144 million per year.

Based on the average 1998–2000 harvest, the provincial government currently collects about $49.5 million per year in stumpage and related payments, other industry taxes and provincial income taxes. Fully harvesting the apportioned volumes of timber in the Kingcome TSA could increase annual revenues by as much as $12 million, the majority of which would be stumpage and related payments.

Kingcome TSA timber supply forecast indicates reductions over the next several decades, with subsequent employment and revenue impacts. Declining coastal timber supplies suggest that regardless of several market challenges currently affecting the industry, the forestry sector along coastal British Columbia will have to adjust to a lower supply of timber.

8 References

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9 Glossary

Allowable annual cut (AAC)

The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres of wood per year.

Analysis unit

A grouping of types of forest — for example, by species, site productivity, silvicultural treatment, age, and or location — done to simplify analysis and generation of timber yield tables.

Base case harvest forecast

The timber supply forecast which illustrates the effect of current forest management practices on the timber supply using the best available information, and which forms the reference point for sensitivity analysis.

Basic sector

Sectors of the economy, such as forestry, tourism and mining, that create flows of income into the region and are assumed to be drivers of the local economy. Non-basic sectors, such as retail outlets, are supported by basic sectors.

Biodiversity (biological diversity)

The diversity of plants, animals and other living organisms in all their forms and levels of organization, including the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.

Biogeoclimatic (BEC) variant

A subdivision of a biogeoclimatic subzone. Variants reflect further differences in regional climate and are generally recognized for areas slightly drier, wetter, snowier, warmer or colder than other areas in the subzone.

Biogeoclimatic zones

A large geographic area with broadly homogeneous climate and similar dominant tree species.

Coniferous

Coniferous trees have needles or scale-like leaves and are usually 'evergreen'.

Culturally modified tree

A tree or a remnant of a tree with evidence of traditional aboriginal forest use.

Cutblock

A specific area, with defined boundaries, authorized for harvest.

Cutblock adjacency

The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested areas must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested. Specifications for the maximum allowable proportion of a forested landscape that does not meet green-up requirements are used to approximate the timber supply impacts of adjacency restrictions.

9 Glossary

Deciduous

Deciduous trees shed their leaves annually and commonly have broad-leaves.

Employment coefficient

The number of person-years of employment supported by every 1000 cubic metres of timber harvested; for example, a coefficient of 1.0 indicates that every 1000 cubic metres harvested supports one person-year, or 500 000 cubic metres supports 500 person-years.

Employment multiplier

An estimate of the total employment supported by each direct job, for example a multiplier of 2.0 means that one direct job supports one additional indirect and induced job.

Environmentally sensitive areas

Areas with significant non-timber values, fragile or unstable soils, impediments to establishing a new tree crop, or high risk of avalanches.

Forest cover objectives

Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives (see **Cutblock adjacency and Green–up**).

Forest inventory

An assessment of British Columbia's timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of other forest values such as recreation and visual quality.

Forest Practices Code

Legislation, standards and guidebooks that govern forest practices and planning, with a focus on ensuring management for all forest values.

Green-up

The time needed after harvesting for a stand of trees to reach a desired condition (usually a specific height) — to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics — before harvesting is permitted in adjacent areas.

Growing stock

The volume estimate for all standing timber at a particular time.

Harvest forecast

The flow of potential timber harvests over time. A harvest forecast is usually a measure of the maximum timber supply that can be realized over time for a specified land base and set of management practices. It is a result of forest planning models and is affected by the size and productivity of the land base, the current growing stock, and management objectives, constraints and assumptions.

9 Glossary

Indirect and induced jobs

Indirect jobs are supported by direct business purchases of goods and services. Induced jobs are supported by employee purchases of goods and services; for example, at retail outlets.

Inoperable areas

Areas defined as unavailable for harvest for terrain-related or economic reasons. Characteristics used in defining inoperability include slope, topography (e.g., the presence of gullies or exposed rock), difficulty of road access, soil stability, elevation and timber quality. Operability can change over time as a function of changing harvesting technology and economics.

Integrated resource management (IRM)

The identification and consideration of all resource values, including social, economic and environmental needs, in resource planning and decision-making.

Landscape-level biodiversity

The *Landscape Unit Planning Guide* provides objectives for maintaining biodiversity at both the landscape level and the stand level. At the landscape level, guidelines are provided for the maintenance of seral stage distribution, patch size distribution and landscape connectivity.

Landscape unit

A planning area based on topographic or geographic features, that is appropriately sized (up to 100 000 hectares), and designed for application of landscape-level biodiversity objectives.

Long-term harvest level

A harvest level that can be maintained indefinitely given a particular forest management regime (which defines the timber harvesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.

Management assumptions

Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specification of minimum harvestable ages, utilization levels, integrated resource guidelines and silviculture and pest management programs.

Mean annual increment (MAI)

Stand volume divided by stand age. The age at which average stand growth, or MAI, reaches its maximum is called the culmination age (CMAI). Harvesting all stands at this age results in a maximum average harvest over the long term.

Model

An abstraction and simplification of reality constructed to help understand an actual system or problem. Forest managers and planners have made extensive use of models, such as maps, classification systems and yield projections, to help direct management activities.

9 Glossary

Natural disturbance type (NDT)	An area that is characterized by a natural disturbance regime, such as wildfires, which affects the natural distribution of seral stages. For example areas subject to less frequent stand-initiating disturbances usually have more older forests.
Non-merchantable forest types	Stands that are accessible and otherwise available for harvesting but are assumed to be non-merchantable due to stand characteristics such as small piece size, incidence of decay, species composition and low stocking.
Old seral	Old seral refers to forests with appropriate old forest characteristics. Ages vary depending on forest type and biogeoclimatic variant.
Operability	Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.
Partition	A portion of the AAC that is attributable to certain types of timber and/or terrain.
Person-year(s)	One person working the equivalent of one full year, defined as at least 180 days of work. Someone working full-time for 90 days accounts for 0.5 person-years.
Protected area	A designation for areas of land and water set aside to protect natural heritage, cultural heritage or recreational values (may include national park, provincial park, or ecological reserve designations).
Pruning	The manual removal of the lower branches of crop trees to a predetermined height to produce clear, knot-free wood.
Regeneration delay	The period of time between harvesting and the date at which an area is occupied by a specified minimum number of acceptable well-spaced trees.
Riparian area	Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.
Scenic area	Any visually sensitive area or scenic landscape identified through a visual landscape inventory or planning process carried out or approved by a district manager.
Sensitivity analysis	A process used to examine how uncertainties about data and management practices could affect timber supply. Inputs to an analysis are changed, and the results are compared to a baseline or base case.
Seral stages	Sequential stages in the development of plant communities that successively occupy a site and replace each other over time.

9 Glossary

Site index

A measure of site productivity. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground). Site index curves have been developed for British Columbia's major commercial tree species.

Stand-level biodiversity

A stand is a relatively localized and homogeneous land unit that can be managed using a single set of treatments. In stands, objectives for biodiversity are met by maintaining specified stand structure (wildlife trees or patches), vegetation species composition and coarse woody debris levels.

Stocking

The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.

Table Interpolation Program for Stand Yields

A B.C. Forest Service computer program used to generate yield projections for managed stands based on interpolating from yield tables of a model (TASS) that simulates the growth of individual trees based on internal growth processes, crown competition, environmental factors and silvicultural practices.

Timber harvesting land base

Crown forest land within the timber supply area where timber harvesting is considered both acceptable and economically feasible, given objectives for all relevant forest values, existing timber quality, market values and applicable technology.

Timber supply

The amount of timber that is forecast to be available for harvesting over a specified time period, under a particular management regime.

Timber supply area (TSA)

An integrated resource management unit established in accordance with *Section 7* of the *Forest Act*.

Tree farm licence (TFL)

Provides rights to harvest timber, and outlines responsibilities for forest management, in a particular area.

Unsalvaged losses

The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) that is not harvested.

Variable Density Yield Prediction model

An empirical yield prediction system supported by the B.C. Forest Service, designed to predict average yields and provide forest inventory updates over large areas (i.e., Timber Supply Areas). It is intended for use in unmanaged natural stands of pure or mixed composition.

Visual quality objective (VQO)

Defines a level of acceptable landscape alteration resulting from timber harvesting and other activities. A number of visual quality classes have been defined on the basis of the maximum amount of alteration permitted.

9 Glossary

Volume estimates (yield projections)

Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products, and for empirical (average stocking), normal (optimal stocking) or managed stands.

Watershed

An area drained by a stream or river. A large watershed may contain several smaller watersheds.

Wildlife tree

A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.

Woodlot licence

An agreement entered into under the *Forest Act*. It allows for small-scale forestry to be practised in a described area (Crown and private) on a sustained yield basis.

Appendix A

Description of Data Inputs and Assumptions for the Timber Supply Analysis

Introduction

In June 2000 a data package for the Kingcome Timber Supply Area timber supply review was released for public review. As a result of public input a number of data and management assumptions have been revised. This appendix presents the revised data package used to produce the timber supply analysis.

The following tables and commentary outline the methods and inputs used to derive the timber harvesting land base, and to construct the timber supply model for the Kingcome TSA timber supply analysis. This information represents current forest management in the area. Current management is defined as the set of land-use decisions and forest and stand management practices currently implemented and enforced. Future forest management objectives that may be intended, but are not currently implemented and enforced are not included in this appendix. The purpose of the timber supply review is to provide information on the effects of current management on both short- and long-term timber supply in each TSA in the province. Any changes in forest management objectives and practices, and any improvements to the data will be included in subsequent timber supply analyses.

A.1 Inventory Information

Table A-1. lists the inventories used to define the timber harvesting land base, and to model forest management activities.

Table A-1. Inventory information

Data	Source	Vintage	Update	Scale
Forest cover	MoF	VRI —1996-97	South re-inventoried 1996-97	1:20 000
		FC1— 1969, 71, 74	North updated in 1994; current to Nov. 1993	
Operability mapping	MoF	1993	2000	1:20 000
Biogeoclimatic classification	MoF	1987	1994	1:250 000
Draft landscape units	MoF	1997	South (VILUP area) — 1999	1:50 000
Visual landscape inventory	MoF	1994-95	1999-2000	1:50 000
ESA mapping	MoF	1978	None	1:20 000
Community watersheds	BCE	1995	None	1:50 000

The forest cover inventory was completed for the entire TSA between 1966 and 1974. This inventory was digitally updated in 1994 in preparation for the last timber supply analysis to account for timber harvesting and natural disturbances that occurred prior to November 1993. In 1996 a new Vegetation Resources Inventory (VRI) was initiated for the TSA. At the time of the analysis, VRI data was available for the southern half of the TSA only. The timber supply analysis used the old (FC1) forest cover inventory for the remainder of the TSA (northern portion). All files (VRI and FC1) were updated to reflect recent harvesting using cutblock maps produced from satellite imagery, forest development plans and information summarized from the Integrated Silviculture Information System (ISIS) records.

Operability mapping

Areas considered operable are those areas inside the TSA, which are feasible to harvest from an economic and physical standpoint based on current management practices.

Operability mapping was first completed in 1993 by forest district staff in consultation with forest licensees operating in the TSA. Operability classes were assigned to delineate areas that are considered operable (A) and inoperable (I). Some remote or isolated areas were not classified (N).

In preparation for the current timber supply review, the 1993 operability mapping was reviewed and updated by Forest Service staff and a forestry consultant during the year 2000. Methodology and results of this review are discussed in further in Section A.3.5.

Mapping and geographic information system (GIS) assessments were conducted by Forest Service staff to determine the operable land base linked to current AAC partitions for low productivity stands and deciduous (alder) stands.

A.1 Inventory Information

Visual landscape inventory

The visual landscape inventory was initially captured on hard copy paper maps in 1994. In 1997 the inventory was then transferred into digital format and updated to meet revised Recreation Branch standards. A new visual landscape inventory was initiated in 1998 and completed during 2000. Although the new inventory has yet to be formally approved by the district manager, it is considered to be the best available information and has been used in the current timber supply analysis.

Environmentally sensitive area mapping

Environmentally sensitive area (ESA) mapping was completed in 1978 for the Kingcome TSA and incorporated into the forest cover inventory file. The forest cover inventory uses a specific labelling system; containing the following categories of ESA: fragile or unstable soils (Es), forest regeneration problems (Ep), snow avalanche (Ea), recreation (Er), wildlife (Ew) and water (Eh). In most cases, two ESA categories are recognized: highly sensitive (1) and moderately sensitive (2). Other inventory methods, such as detailed terrain survey mapping are also utilized to identify areas that require management that may exclude or reduce their contribution to the timber harvesting land base. A combination of forest cover inventory ESAs and ESAs identified through other inventory methods have been used to identify environmentally sensitive areas for the current timber supply review.

Community watersheds

Three community watersheds are located within the TSA: the Tsulquate River (4500 hectares — District of Port Hardy), and Quaee/N.Quaee Creeks (410 hectares — Tsawataineuk First Nation). The total forested area within community watersheds in the Kingcome TSA is 4055 hectares of which 518 hectares is timber harvesting land base.

A.2 Zone and Analysis Unit Definitions

A.2.1 Management zones and tracking of multiple objectives (grouping)

Management zones differentiate areas with distinct management emphasis and homogenous forest cover. For example, a zone may be based on a harvesting system, silvicultural system, visual quality class or wildlife consideration.

Table A-2. Objectives to be tracked

Group	Objectives	Comment
1	**"Known" scenic areas** Known scenic areas with RVQC = preservation Known scenic areas with RVQC = retention Known scenic areas with RVQC = partial retention Known scenic areas with RVQC = modification All other areas	Application of recommended visual quality class to scenic areas that have been made known by the district manager.
2	**Visual areas** Visual areas with RVQC = preservation Visual areas with RVQC = retention Visual areas with RVQC = partial retention Visual areas with RVQC = modification All other areas	Application of recommended visual quality class to all visual area identified in the visual landscape inventory.
3	**Draft landscape units and biogeoclimatic variant**	Draft landscape unit number as indicated on mapping.
4	**Community watersheds**	Community watershed areas.
5	**Vancouver Island Land Use Plan**	Vancouver Island Land Use Plan, including enhanced forestry zones and special management zones.
6	**Central Coast Land and Coastal Resource Management Plan**	Proposed protection areas, option areas and special management zones.
7	**Operable — low-site land base**	Operable low-site areas (conifer) defined through the review of operability mapping.

RVQC = recommended visual quality classes.

A.2 Zone and Analysis Unit Definitions

A.2.2 Analysis units

An analysis unit represents a combination of stands dominated by specific tree species or a silvicultural regime with a specific timber growing capability — as indicated by the inventory type group and sites index in the forest inventory file. Each analysis unit is assigned its own timber volume projections (yield tables) for existing and future stands. In the TSA, cedar (*Thuja plicata* + *Chamaecyparis nootkatensis*), sitka spruce (*Picea sitchensis*) and hemlock (*Tsuga heterophylla* + *Tsuga mertensiana*) stands are grouped into analysis units on the basis of leading species and site index. The criteria for dividing stands into these are shown in Table A-3.

Table A-3. Definition of analysis units

No.	Analysis unit	Timber harvesting land base (hectares)	Species	Inventory type groups	Site index range[a]
1	Cedar — good	16 569	Cw/Cy	9-11	SI ≥ 20
2	Cedar — medium	24 428	Cw/Cy	9-11	20 > SI ≥ 15
3	Cedar — poor	32 849	Cw/Cy	9-11	SI < 15
4	Hemlock/balsam — good	27 682	Hw	12-20	SI ≥ 25
5	Hemlock/balsam — medium	33 985	Hw	12-20	25 > SI ≥ 20
6	Hemlock/balsam — poor	24 928	Hw	12-20	SI < 20
7	Spruce/fir— all	7 009	S	21-26	—
8	Alder	1 077	D	37-38	—

(a) Sites index reference age is 50 years at breast height.

A.3 Definition of the Timber Harvesting Land Base

A.3.1 Land not administered by the British Columbia Forest Service for timber supply

Ownership codes are generally used to identify whether the land can be considered to contribute to timber supply. Ownership codes 62C, 61C and 69C indicate Crown land in a forest management unit, Crown land in use, recreation and enjoyment of public (UREP) and miscellaneous reserves, respectively. These are generally the only ownership codes which are considered to contribute to timber supply. Ownership code 70N, timber licence land in a TSA, is considered under Section A.3.14. Areas with other ownership codes are removed from the land base considered for timber supply. This includes woodlot licence areas since their AACs are determined independently from the timber supply review process.

A.3.2 Land classified as non-forest

The VRI Phase 1 mapping includes the classification of areas following the British Columbia land cover classification scheme. This classification was used to identify non-vegetated areas such as lakes, rock and ice and non-forest areas such as wetlands and alpine meadows removed from the land base considered for timber supply.

In the area not covered by the VRI, the inventory type identity variable included in the forest cover classification was used to identify non-forest areas.

A.3.3 Non-productive forest cover

In the area covered by the VRI, non-productive and non-commercial forest areas were identified using a combination of the British Columbia land cover classification scheme, tree species type, stand age, crown closure and site index. Areas considered to be non-productive include forest cover polygons with no logging history that:

- have no assigned species and no site index;
- have site index under 5 metres;
- are mature stands with crown closure under 10% (under 30% for hemlock).

In the area not covered by the VRI, the inventory type identity variable included in the forest cover classification was used to identify non-productive and non-commercial forest.

A.3 Definition of the Timber Harvesting Land Base

A.3.4 Environmentally sensitive areas

Environmentally sensitive areas (ESA) mapping is a component of the forest cover inventory for the Kingcome TSA. This ESA mapping was completed in 1978 for a variety of non-timber values. In some cases, this ESA mapping remains the "best available information" on a particular resource value or feature and is used in this timber supply analysis. In other cases, as outlined below, additional information has been acquired and is used in place of the original ESAs. Per cent area reductions were used to reduce the timber harvesting land base labelled with ESAs. The reductions applied for a particular ESA are outlined in Table A-4. Generally speaking, the higher the value or sensitivity of the ESA, the higher per cent reduction that is applied.

Table A-4. Description of environmentally sensitive areas

ESA category	ESA description	Reduction per cent (%)
SI or Terrain class V	High likelihood of landslide initiation following timber harvesting or road construction.	80
S2 or Terrain class IV	Moderate likelihood of landslide initiation following timber harvesting or road construction.	20
R1	Recreation — high sensitivity.	100
R2	Recreation — moderate sensitivity.	50
W1	Wildlife habitat — high value.	100
W2	Wildlife habitat — moderate value.	50
P1 or P2	Difficult regeneration.	100
A1	Avalanche buffer.	100
H1 or H2	Watershed values.	N/A

Data source and comments:

ESA soils and terrain class IV and V

During the last timber supply review, the 1978 ESA mapping for areas of sensitive terrain was found to have some limitations. In particular, no areas of moderately sensitive terrain (Es2) had been mapped. Forest district staff conducted a study of detailed terrain stability to attempt to quantify the potential mapping problem. That study indicated that while there appeared to be only a slight underestimation of Class V areas (Es1), a large area (up to 20 000 hectares of operable forest) of potential Class IV (Es2) area had not been identified.

To estimate the area of Es2 within the TSA for this analysis a geographic information system (GIS) analysis was conducted to overlay terrain stability overview assessments (where available) and mapped slope classes. Results of this analysis were then used to predict the amount of Class IV (which was assumed to be equivalent to Es2). The following slope-based factors were then applied to predict the area of operable land base in unstable terrain incremental to ESA (S1) listed in Table A-4. Based on the reduction per cent for moderately sensitive soils in Table A-4., 20% of these areas were considered excluded from the timber harvesting land base.

Slope	Predicted per cent (%) of Class IV terrain
0-20%	3.5
21-40%	15.8
41-60%	38.9
61-80%	50.6
81-100%	43.1
101+%	32.7

Er (recreation)

The Er category identifies areas having significant value for recreational activities. Initially, Er mapping also identified areas of outstanding landscape (visual) features, however this component of the Er mapping has since been captured within the visual landscape inventory.

Recreational features are defined as a physical, biological, cultural or historic aspect of an area making it attractive for actual or potential recreational use. Only features of exceptional quality, uniqueness and availability having recreational, educational, scientific or heritage value were considered for Er designation.

A recreation features inventory is nearing completion and will update and enhance the Er mapping. A digital version of this new inventory was not available for use in this analysis. As a result, Er mapping was utilized to reflect the current management in the TSA. In high value recreation areas (Er1), timber harvesting is likely to be severely limited, therefore a 100% netdown was be applied. A 50% netdown was assumed for Er2 areas. Similar assumptions were used in the previous timber supply review.

Ew (wildlife)

The Ew category identifies areas having significant value for food, shelter, or reproduction for wildlife. When Ew mapping for the Kingcome TSA was conducted approximately 20 years ago, high value areas (Ew1) were intended to identify areas of critical importance to wildlife, where the removal of any timber would be detrimental. Some conditional harvesting was deemed as acceptable within moderate value areas (Ew2). In the Kingcome TSA, Ew areas were primarily winter range areas for ungulate species — deer and elk on Vancouver Island and mountain goats on the mainland.

Areas of 1125 hectares of Ew1 and 1183 hectares of Ew2 were netted out of the land base in the last timber supply review for wildlife management, primarily for ungulates, as indicated above. These areas are currently under review by the Ministry of Forests (MoF), Ministry of Water, Land and Air Protection (MWLAP) and forest industry staff. This review may result in the confirmation or revision of existing areas, or delineation of new areas. Ultimately, agreed to areas will be established as ungulate winter ranges (UWR) under *Section 69* of the *Operational Planning Regulation*. As the review was not completed in time for this timber supply analysis, existing Ew mapping were applied.

Ea (avalanche)

Ea's are intended to protect manmade structures and valuable natural resources from snow avalanches by preventing the removal of forest cover from steep slopes in snow belts. A 100% netdown was applied to these areas in the timber supply analysis.

Ep (difficult regeneration)

The Ep category identifies areas having actual or potentially severe regeneration problems, as a result of geoclimatic (e.g., soil, frost, drainage, elevation, aspect) or biotic (e.g., brush, wildlife browse) factors. A 100% netdown was applied to these areas in the timber supply analysis.

Eh (watershed)

No reductions were applied for Eh areas since the forest cover requirements set out in the *Community Watershed Guidebook* are modelled. This approach is more representative of the current management regime under the *Forest Practices Code*.

A.3 Definition of the Timber Harvesting Land Base

A.3.5 Areas considered inoperable

Operability codes are generally used to describe the presence or absence of physical barriers or limitations to harvesting, logging methods, and the merchantability of stands. Since physical and economic conditions are highly variable across British Columbia, the methodology used to interpret and map operability is highly variable and district dependent.

Operable — conventional land base

In order to refine the operability assumptions for this analysis, a review of timber availability within the Kingcome TSA was undertaken. This review involved:

- an examination of forest development plans within the TSA to determine development patterns and to evaluate where logging has taken place and is planned to take place;
- an examination of scaled timber volumes harvested, by species and year, for the period between 1992 and 1999;
- a helicopter overview;
- and quantitative analysis of available forest cover maps, logged area maps and slope class maps for the Kingcome TSA.

Based on the results of this review, the TSA was stratified into five operability zones and the following assumptions were used to define the operable land base in each zone.

Zone 1 — West Coast Vancouver Island

- exclude inoperable areas (based on 1993 operability classification);
- exclude low volume stands (cedar-leading sites less than 350 cubic metres per hectare; hemlock, balsam, spruce, fir-leading sites less than 500 cubic metres per hectare).

Zone 2 — Outer Coast — (excluding low site area)

- ignore operability lines;
- exclude low volume stands (cedar-leading sites less than 350 cubic metres per hectare; hemlock, balsam, spruce, fir-leading sites less than 500 cubic metres per hectare).

Zone 3 — Broughton/Gilford

- exclude inoperable areas (based on current 1993 lines);
- exclude low volume stands (cedar-leading sites less than 350 cubic metres per hectare; hemlock, balsam, spruce, fir-leading sites less than 500 cubic metres per hectare).

Zone 4 — Mainland Inlets

- exclude inoperable areas (based on current 1993 lines);
- exclude low volume stands (cedar-leading sites less than 350 cubic metres per hectare; hemlock, balsam, spruce, fir-leading sites less than 500 cubic metres per hectare);
- additional mapsheet reductions to exclude uneconomic or inaccessible areas classified as operable in the 1993 operability mapping;
- exclusion of sites with over 80% slope.

Zone 5 —Klinaklini Supply Block

- entire supply block considered inoperable.

As with low-site coniferous areas, the 1993 operability mapping for the TSA did not consider and incorporate potential alder harvest areas. Additional analysis was conducted by forest district staff to identify operable alder stands. This involved a mapsheet review in which the per cent of alder-leading stands considered operable was determined.

A.3.6 Sites with low timber growing potential

Sites may have low timber productivity either because of inherent site factors (nutrient availability, exposure, excessive moisture, etc.), or because they are not fully occupied by commercial tree species. As these stands are not considered to be harvestable, they need to be identified and removed from consideration for the timber harvesting land base.

Table A-5. Description of sites with low timber growing potential

Species group	Inventory type group	Volume criterion (m^3/hectare)		Site index[a] (metres)	Reduction (%)
Cedar (not in Hecate Lowlands)	9-11	NMV< 350 m^3/ha	and[b]	SI < 12.7	100
Cedar (in Hecate Lowlands)	9-11	NMV< 340 m^3/ha	and	SI < 12.4	100
Hemlock/Balsam	12-20	NMV< 500 m^3/ha	and	SI < 13.8	100
Spruce	21-26	NMV< 500 m^3/ha	and	SI < 10.8 (Ss)	100
Fir	1-8	NMV< 500 m^3/ha	and	SI < 20.2 (Fd)	100
Alder	1-8	Based on mapsheet operability factors			

(a) The site index values in Table A-5. are the site indices required for each stand type to achieve the NMV volume criteria at 150 years. These were calculated using the VDYP yield model (core version 6.4a).

(b) For a stand to be excluded it should fail to meet both the minimum volume requirement and the minimum SI requirement.

A.3 Definition of the Timber Harvesting Land Base

A.3.8 Unmerchantable forest types

Unmerchantable forest types are stands that are physically operable and exceed low site criteria but are not currently utilized or have marginal merchantability. These types are excluded from the timber harvesting land base.

Table A-6. Unmerchantable forest types criteria

Species	Inventory type groups	Reduction per cent (%)
Deciduous other than alder	35, 36, 39, 42	100
Pine	27-32	100

Deciduous other than alder (cottonwood)

Distribution of merchantable cottonwood stands through the TSA is limited and localized in the valley bottoms of a few of the larger river valleys. Forest inventory information for cottonwood tends to be less reliable as these areas were not intensively measured or assessed during the 1970's forest inventory process, which focused on merchantable coniferous species. Historically, cottonwood has been considered as an unmerchantable tree species; however Scott Paper was awarded a deciduous non-replaceable forest licence in 1989 for this species. Scott Paper currently operates in the Kingcome River watershed and expects to remain in that area for at least ten more years. As a result, more detailed inventory information on cottonwood has been collected for the Kingcome TSA. Some preliminary reconnaissance has also been done by Scott Paper in the Wakeman drainage. The timber supply analysis excluded cottonwood stands. A separate timber supply assessment for cottonwood will be completed using more accurate localized inventory information.

Pine

Coastal lodgepole pine dominated stands are generally indicative of poor productivity and are not harvested. These stands were excluded from the timber harvesting land base.

A.3.9 Roads, trails and landings

Separate estimates are made for the loss of productive forest land due to existing and future roads, trails and landings (RTL). Existing RTL estimates are applied as reductions to the current productive forest considered available for harvesting and future RTL reductions are applied after stands are harvested for the first time in the simulation model. Estimates were applied as the percentages of area to be removed from specified age classes.

A.3 Definition of the Timber Harvesting Land Base

Table A-7. Estimates for existing and future roads, trails and landings

Location	Year of harvest	Reduction per cent (%)
Existing RTLs		
Roads, trails and landings	Pre-1995	7.0
Roads, trails and landings	1995-1999	6.0
Future RTLs		
Roads, trails and landings	Post-1999	6.0

Data source and comments:

Pre-1995 netdowns for roads, trails, and landings are based on estimates prepared for the last timber supply review, which reviewed 303 harvest blocks from 1987 to 1995. A sample updated to 1999 shows decreased site degradation, likely due in part to increased use of helicopter logging. It is anticipated that 6.0% accurately represent the long-term area to be occupied by roads, trails and landings within the Kingcome TSA.

A.3.10 Wildlife tree retention

The *Forest Practices Code Landscape Unit Planning Guide* (*LUPG*) recommends retention of wildlife tree patches (WTPs) for providing stand structure over time. Wildlife tree patches (group reserves) larger than two hectares in size can also contribute to old-seral stage forest requirements at the landscape level.

The WTP retention targets were calculated for each landscape unit using Table A3.1 of the *LUPG*. Table A3.1 was used for deriving the WTP targets because landscape level old-seral retention targets have been applied in the timber supply analysis. WTP target calculations were based on the proportion of each landscape unit that is harvestable, and the percentage of the harvestable area that has already been harvested. The calculated targets were subsequently reduced by 75% as per the assumption used in the *Forest Practices Code Timber Supply Analysis*, February 1996. This assumes that 75% of the WTP requirements will be met by riparian reserves and other areas outside of the timber harvesting land base. The percentage of the timber harvesting land base required for WTPs ranges between 0.125 to 3.0% by landscape unit using this approach.

Table A-8. Reductions to reflect area retention in cutblocks for wildlife tree patches

Biogeoclimatic ecosystem classification (BEC) subzone	Timber harvesting land base within subzone (%)	Mean area weighted WTP retention target (%)	Mean area weighted residual area estimate on the timber harvesting land base (%)
CWHvh	31.11	5.6	1.40
CWHvm	68.55	7.4	1.84
CWHxm	0.06	14.0	3.50
CWHdm	0.04	4.6	1.14
MHmm	0.24	2.1	0.52

A.3 Definition of the Timber Harvesting Land Base

A.3.11 Cultural heritage resource reductions

Many portions of the TSA possess significant archaeological and cultural heritage values, particularly culturally modified trees (CMTs) and shell middens. An archaeological overview assessment (AOA) completed in 1995, the Galgalis Traditional Use Study and consultation with First Nations during operational plan development all help to identify areas of sensitivity. Archaeological impact assessments (AIA) are conducted by licensees as directed by the forest district manager. Often, the cultural resource values are not within the timber harvesting land base, or the recommendations of the AIA are such that there is no impact on the timber harvesting land base. As a result, no specific netdown has been applied for management of cultural resources in this timber supply analysis.

A.3.12 Riparian reserve zones and riparian management zones

To account for riparian reserve zones (RRZ), the timber harvesting land base was reduced by a total of 4.7%. This figure is based on a district review of silvicultural prescriptions for 50 cutblocks approved between December 1995 and April 1999, and reflects the actual merchantable area left unharvested in riparian reserve zones within the TSA. This figure is very close to that of work conducted by Wild Stone Resources in 1994, which determined a 4.8% land base reduction based upon an audit of 92 coastal cutblocks.

Based upon the stream class distributions found in the Wild Stone study, application of best management practices within riparian management zones (RMZ) equates to a 4.2% timber harvesting land base impact. This is the level of impact that was assumed during the *Forest Practices Code Timber Supply Analysis*, February 1996 and was the assumption used in the base case forecast. While initial analysis by forest district staff seemed to indicate the Wildstone based impacts might have been too large for application in the Kingcome TSA, examination of an additional 50 cutblocks approved since April 1999 suggests higher levels of retention are occurring. Gully management practices also result in additional timber retention on some smaller streams. As a result of this most recent analysis, forest district staff are of the opinion that the 4.2% area reduction applied in the base case forecast is reasonable for riparian management zones in the Kingcome TSA. This reduction has been applied as a per cent area retention rather than per cent volume retention.

A.3.13 Exclusion of specific, geographically defined areas

While road construction has approached to within approximately ten kilometres of the southern boundary of the Klinaklini Supply Block, there is no indication of planned access into this area within the next five years or more. As a result, this area was not considered available, and was excluded from the timber supply analysis. The forested lands of the Klinaklini Supply Block have recently been identified as a proposed protection area as a result of the CCLRMP process.

A.3 Definition of the Timber Harvesting Land Base

A.3.14 Timber Licence reversions

Timber Licences are old tenure arrangements that give a licensee exclusive rights to harvest merchantable timber within the licence area and do not contribute to the TSA allowable annual cut. Once these areas have been harvested, regenerated and attain free-growing status, the timber license area reverts to Forest Service jurisdiction. Accordingly, these areas are included in the timber harvesting land base after the first harvest and contribute to the TSA harvests in medium- to long-term timber supply.

Timber Licence areas need to be accounted for from the time the stands have been harvested, and/or from the time the stands will be harvested. Time of harvest is used as the reference point so that impact of these harvests on forest cover requirements is given full consideration in the timber supply analysis. In some cases stands that have been harvested and legally reverted have not had the necessary ownership change on the inventory file (e.g., change from 70-N to 62-C). A total area of 6205 hectares of unreverted timber licences remain in the Kingcome TSA. This amounts to approximately 3.7% of the timber harvesting land base.

A.4 Forest Management Assumptions

A.4.1 Harvesting

A.4.1.1 Utilization levels

The utilization levels define the maximum stump height, minimum top diameter inside bark (dib) and minimum diameter at breast height (dbh) by species. These are used in the analysis to calculate merchantable volume.

Table A-9. Utilization levels

Analysis units	Minimum dbh (cm)	Maximum stump height (cm)	Minimum top dib (cm)
All — natural	17.5	30	10
All — managed	12.5	30	10

Table A-9. reflects current regional standards, licence requirements and current management.

A.4.1.2 Volume exclusions for mixed species stands

Deciduous species in a predominantly coniferous stand are not normally harvested. Therefore, the unharvested portions will not contribute to the estimated stand volume in the timber supply analyses.

Table A-10. Volume exclusions for mixed species types

Species	Volume exclusion (%)
Deciduous (in coniferous-leading stands)	100

A.4.1.3 Minimum harvestable age derivation

The minimum harvestable age is the time required for stands to grow to a harvestable size, and defines the lower limit for harvesting. Minimum harvestable ages are minimum criteria. Harvesting may occur in stands at the minimum age in order to meet forest level objectives (e.g., maintaining harvest levels for a short period of time, or avoiding large inter-decade changes in harvest levels). However, many stands will not be harvested until past the minimum age due to management objectives for other resource values (e.g., requirements for the retention of older forest).

The minimum harvestable age for stands in each analysis unit were set to the greater of: a) the estimated age at which the stand is predicted to reach a required volume; and b) the age at which the stand's mean annual increment (MAI) achieves a value of 95% of the maximum (culmination). The minimum harvestable ages used in the base case are listed in Table A-11.

Table A-11. Minimum harvestable ages

#	Analysis unit	Existing stand minimum harvestable age (years)	Managed stand minimum harvestable age (years)
1	Cedar — good	70	75
2	Cedar — medium	105	90
3	Cedar — poor	150	130
4	Hemlock/balsam— good	60	55
5	Hemlock/balsam — medium	90	70
6	Hemlock/balsam — poor	140	115
7	Spruce/fir	80	70
8	Alder	50	50

A.4.1.4 Silvicultural systems

The majority of the area harvested in the Kingcome TSA is reforested under a clearcut with reserves silvicultural system. The landscape unit-specific per cent retention levels are equal to the reserve requirements for wildlife tree patches (WTPs) calculated from Table A3.1 of the *Landscape Unit Planning Guide*. Forest district staff anticipate that approximately 75% of the area harvested over the next five year period will be done by clearcut with reserves.

While historically there has been little use of retention silvicultural systems (e.g., shelterwood, selection or patch cut) in the Kingcome TSA, this is rapidly changing. Recently several licensees in the TSA have made public commitments to use retention systems on some or all of their operating areas. These plans are currently being implemented. Based upon an assessment of recent licensee plans it appears that about 25% of cutblocks have been approved as retention blocks. However, there is considerable variation in the amount and distribution of retained area within these cutblocks as licensees and district staff gain experience with implementation.

At this point, forest district staff do not feel they have enough information on hand to be able to assume if there is an incremental timber supply impact due to retention systems or to quantify this impact—no such impact has been applied in the base case forecast.

A.4 Forest Management Assumptions

A.4.2 Unsalvaged losses

Table A-12. shows the estimated average annual unsalvaged volumes that are lost to fires and wind damage over the long term on the timber harvesting land base. It is the opinion of forest district and regional staff that epidemic insect and disease losses are estimated to be minimal with no apparent volume losses to the TSA.

Table A-12. Unsalvaged losses

Cause of loss	Annual unsalvaged loss (m^3 per year)
Fire	3 083
Windthrow	10 500
Total	13 583

Data source and comments:

Fire information is based on Forest Service Protection Branch information and represents the average losses over the past ten year period. Windthrow losses are based on district staff visual estimates of approximately 15 hectares per year, assuming an average stand volume of 700 cubic metres per hectare.

A.4.3 Silviculture

A.4.3.1 Regeneration activities in managed stands

Recent plantations and future stands will be grown on managed stand yield tables (MSYTs) produced using the Forest Service TIPSY growth and yield model. Table A-13. below contains the inputs required to produce MSYTs for this analysis.

A.4 Forest Management Assumptions

Table A-13. Regeneration assumptions by analysis unit

No.	Analysis unit	Regen delay[a] (years)	Age of stock (years)	OAFs		Method		Regen analysis unit (AU)		Density	
				1	2	Type	%	AU	%	Initial	Thin
1	Cw Good	2	1	15	5	Artificial	93	1	100	3000	—
2	Cw Medium	3	1	15	5	Artificial	96	2	100	3000	—
3	Cw Poor	3	1	15	5	Artificial	100	3	100	3000	—
4	Hw/B Good	3	1	15	5	Artificial	77	4	100	5000	—
5	Hw/B Medium	3	1	15	5	Artificial	66	5	100	5000	—
6	Hw/B Poor	5	1	15	5	Artificial	92	6	100	5000	—
7	Ss	2	1	15	5	Artificial	100	7	100	2000	—
8	Dr	4	1	15	5	Artificial	100	8	100	5000	—
8[b]	Dr (20 ha/year)	4	1	15	5	Artificial	100	8	100	1600	—

(a) Regeneration delays were adjusted by the Port McNeill Forest District staff since the original data package was released.

(b) Under the Vancouver Forest Region red alder strategy, in the next five years, 20 hectares a year of red alder will be planted in the Kingcome TSA. For analysis purposes, 20 hectares of the red alder analysis unit will be reforested back to red alder.

Data source and comments:

The average actual regeneration delay was obtained from the review of all ISIS records. The method type and per cent represents the average per cent of the areas that were planted (artificially reforested). These areas will be considered as managed stands for modelling purposes. Given the current maximum density policy, it is not anticipated that any opening will be spaced prior to free-growing declaration. Therefore the estimates of initial density represent the expected densities of regenerated stands with the natural in-fill of regeneration.

Note that most alder sites that are harvested in the TSA are currently regenerated to coniferous species, primarily hemlock. Generally, these sites are highly productive for conifers (SI > 25). In exceptional circumstances, regeneration to alder is deemed acceptable; this area has been negligible to date and has not been reflected in the above table. Should future silvicultural regimes change and regeneration to alder become more prevalent, this will be reflected in future analyses.

Operational adjustment factors (OAF) are used to adjust the potential yields generated from TIPSY to reflect actual yields achieved under operational conditions. OAF 1 reduces the potential yields by a constant percentage to reflect small stocking gaps within stands incapable of growing trees. OAF 2 reduces potential yields to reflect losses due to pests, disease and decay. OAF 2 increases with age and for this analysis, passes through 5% at age 100.

A.4.3.2 Immature plantation history

The purpose of this section is to identify areas of existing immature forest where the density (stems per hectare) was controlled and therefore should be assigned to a managed stand yield curve (TIPSY).

Table A-14. Immature plantation history

Analysis unit	Area managed (hectares or per cent)			
	Age 1 – 10	Age 11 – 20	Age 21 – 30	Age 31 – 40
All	100%	36%	12%	0%

A.4.3.3 Not satisfactorily restocked (NSR) areas

Land classified in the Kingcome TSA Forest Inventory Planning (FIP) file as type identity 4 or 9 is included in the current timber harvesting land base. These type identities indicate not satisfactorily restocked land base. There is no NSR classification in the VRI mapping. Logged and regenerating areas were identified based on stand attributes, stand history attributes and the logged areas mapping developed from satellite imagery. The total area of regenerating forest in the Kingcome TSA is 5543 hectares. This area is scheduled to be restocked within the regeneration delay period.

A.4.3.4 Tree improvement

Information on the proportion of planting stock that is Class A (selected) was compiled for all analysis units. The average current genetic gain was weighted by the proportion of Class A stock used to arrive at the values in Table A-15. below. The following genetic gains have been included in volume tables for future regenerated stands in the base case. Volume tables for existing regenerated stands (generally 30 years and less) do not have tree improvement gains incorporated.

Table A-15. Tree improvement gains

Species	Volume gain at 80 years (%)
Western hemlock	2.5
Redcedar	5.2

A.4.4 Forest cover requirements

The TSA was divided into management zones which define areas of distinct management emphasis and similar forest cover in the TSA. Since the computer simulation model used for the timber supply analysis can track multiple objectives for an area, management zones can overlap. For example, a landscape unit that is managed for biodiversity may be partly covered by a visually sensitive area. The objectives for each area specify requirements to retain different forest characteristics across the landscape, such as a minimum percentage of old-growth forests or a maximum percentage of forest area below green-up height.

A.4 Forest Management Assumptions

Integrated resource management and visual values

In order to limit the impact of harvesting on visual, wildlife, hydrological and other values in the TSA, the forest cover requirements outlined in Table A-16. will be applied to areas that fall into each of the "Level 1" groupings (cutblock adjacency and visual quality).

Table A-16. Forest cover requirements for cutblock adjacency and visual values

Zone or group	Green-up height (metres)	Mean allowable area not greened-up (%)	Area to apply constraint
RVQC = preservation	5	0.6	Crown forested area
RVQC = retention	5	3.0	Crown forested area
RVQC = partial retention	5	9.7	Crown forested area
RVQC = modification	5	20.5	Crown forested area
Integrated resource management (IRM) areas	3	25.0	Timber harvesting land base

The maximum denudation in the visual zones was determined for each individual RVQC — landscape unit combination. Values shown in this table are area-weighted averages for each visual quality class.

Visual constraints restrict the amount of harvesting within visual landscapes. Forest cover requirements for recommended visual quality classes (RVQCs) have been determined using the document *Procedures for Factoring Visual Resources into Timber Supply Analysis* (March 1998). All visual zones are managed to a green-up height of 5 metres. The maximum allowable disturbance not greened-up (maximum alteration) in visual zones were assigned to each RVQC — landscape unit combination based on the visual absorption capacity of the areas as specified in the *Procedures for Factoring Visual Resources into Timber Supply Analyses (March 1998).* The maximum denudation applied were spread across the recommended ranges. The integrated resource management zone is managed to a green-up height of 3 metres and a 25% maximum denudation.

Community watersheds

In order to protect water quality, management in community watersheds was accounted for by limiting harvesting in each watershed to a maximum of 1% of the forested area per year.

A.4 Forest Management Assumptions

Landscape-level biodiversity

To ensure that older forests are maintained reasonably evenly within the TSA, the forest cover requirements outlined in Table A-17. will be applied to each draft landscape unit/biogeoclimatic variant group[11]. These requirements were derived from the *Landscape Unit Planning Guide.*

Table A-17. Forest cover requirements — biogeoclimatic units and natural disturbance type (NDT) within the Kingcome TSA (applied to gross productive forest)

Biogeoclimatic zone[a]	NDT	Minimum old growth retention area by decade (%)			Minimum age (years)
		1 to 7	8 to 14	15 to 21	
CWH	1	9.7	11.7	13.6	250
CWH	2	6.7	8.1	9.4	250
MH	1	14.2	17.1	19.9	250
IDF	4	9.7	11.7	13.6	250

(a) The percentages listed in the table apply to all variants within the zones shown.

Data source and comments:

Interim biodiversity emphasis options (BEOs) have been assigned to each landscape unit through the Regional Landscape Unit Planning Strategy. However, these BEOs and specific objectives for old-growth management have not yet been legally established. Therefore a single old-seral stage requirement was developed based on the anticipated distribution of 10% high-, 45% intermediate- and 45% low-emphasis for the base case. The values shown in Table A-17. reflect the weighted *Landscape Unit Planning Guide* values. They are based on the requirements to achieve one-third of the full requirement in the first 70 years, two-thirds in the second 70 years, and the full requirement by the end of three 70-year rotations, or 210 years from now in the lower-emphasis areas.

(11) Landscape unit boundaries and BEO assignments as submitted to the chief forester in the Vancouver Regional Landscape Unit Strategy, July 7, 1999.

A.5 Volume Estimates for Existing Stands

The variable density yield projection (VDYP) model, version 6 4a developed and supported by the B.C. Ministry of Forests was used to estimate timber volumes for existing natural stands. Table A-18. shows the volume estimates by analysis unit for existing natural stands.

Table A-18. Timber volume tables for existing natural stands (cubic metres)

Age	Cedar—good	Cedar—medium	Cedar—poor	Hem/Bal—good	Hem/Bal—medium	Hem/Bal—poor	Spruce/Fir	Alder
10	0	0	0	0	0	0	0	3
20	0	0	0	12	0	0	20	72
30	38	0	0	154	47	1	95	171
40	128	32	4	290	154	41	207	243
50	213	90	41	406	247	110	308	299
60	293	146	86	505	329	174	397	342
70	364	197	127	589	400	231	473	363
80	431	246	166	661	463	282	539	382
90	492	290	202	723	518	327	597	399
100	548	332	236	778	568	368	648	414
110	601	370	268	826	612	405	693	428
120	644	402	295	867	650	437	732	440
130	688	434	320	907	687	469	768	451
140	727	462	343	942	721	497	799	462
150	761	486	362	974	751	523	827	471
160	791	507	379	1002	778	546	850	479
170	816	524	393	1027	801	567	870	486
180	843	543	408	1050	824	587	887	493
190	868	562	423	1072	846	606	905	500
200	893	579	437	1091	865	624	921	506
210	917	596	450	1109	884	641	937	511
220	945	616	466	1126	901	656	952	517
230	973	636	482	1141	917	671	965	523
240	1000	656	497	1154	932	685	979	528
250	1026	674	512	1167	946	698	991	533
260	1029	677	514	1174	953	705	999	535
270	1032	679	516	1181	960	712	1007	537
280	1035	681	518	1187	965	719	1014	539
290	1037	683	519	1192	970	725	1021	541
300	1039	685	520	1196	975	730	1027	543
310	1041	686	522	1200	979	735	1033	545
320	1042	688	523	1203	982	740	1039	546
330	1044	689	524	1205	985	744	1045	547
340	1045	690	525	1207	988	748	1050	549
350	1046	692	526	1209	990	751	1055	550

A.6 Volume Estimates for Existing Regenerated Stands

WinTIPSY (BatchTipsy Version3.0a) B.C. Ministry of Forests, Research Branch, was used to estimate growth and yield for existing and future managed stands. The area-weighted site index and regeneration assumptions for each analysis unit were used as inputs to TIPSY. Tree improvement gains are not included in existing managed stands. Operational adjustment factors (OAFs) used in existing managed stand yield table generation were:

OAF 1 of 15% (a constant percentage reduction at all ages to represent incomplete site occupancy, for example, small holes in a stand), and;

OAF 2 of 5% (an increasing reduction, to represent losses such as decay that increase with stand age).

Table A-19. Timber volume tables for managed stands (cubic metres)

Age	Cedar—good	Cedar—medium	Cedar—poor	Hem/Bal—good	Hem/Bal—medium	Hem/Bal—poor	Spruce/Fir
10	0	0	0	0	0	0	0
20	2	0	0	21	1	0	4
30	54	3	1	187	50	4	94
40	189	34	6	365	175	37	246
50	325	108	33	536	297	120	396
60	431	184	82	687	408	198	538
70	548	252	132	830	517	266	673
80	660	317	177	942	607	327	790
90	741	366	218	1051	696	383	895
100	829	408	257	1153	776	436	992
110	922	455	295	1251	850	490	1078
120	993	499	326	1326	908	533	1151
130	1055	540	349	1395	961	574	1217
140	1115	576	369	1465	1014	610	1270
150	1166	609	386	1525	1066	648	1316
160	1213	639	404	1567	1115	683	1352
170	1252	660	421	1611	1159	715	1386
180	1288	678	439	1657	1203	743	1409
190	1318	696	454	1701	1236	767	1432
200	1350	711	469	1741	1262	792	1448
210	1380	726	480	1774	1285	813	1463
220	1415	747	498	1798	1309	830	1476
230	1453	768	511	1821	1334	845	1488
240	1480	792	525	1843	1357	859	1496
250	1504	812	537	1864	1378	870	1501
260	1528	829	547	1884	1399	882	1506
270	1550	851	560	1901	1415	895	1507
280	1569	863	570	1917	1427	907	1510
290	1588	874	581	1933	1439	916	1516
300	1589	875	581	1937	1442	917	1516
310	1589	875	581	1937	1442	917	1516
320	1589	875	581	1937	1442	917	1516
330	1589	875	581	1937	1442	917	1516
340	1589	875	581	1937	1442	917	1516
350	1589	875	581	1937	1442	917	1516

Appendix B

Socio-Economic Analysis Background Information

B.1 Limitations of Economic Analysis

The socio-economic analysis identifies employment and income impacts, changes in government revenues and community impacts at various harvest levels and times in the future. Some of the assumptions used in the analysis are as follows:

- **Employment multipliers** — these multipliers are used to estimate indirect and induced employment impacts of a change in direct industry activity. Employment multipliers are calculated based on analytical assumptions and data collected at a specific time. Consequently, the multipliers reflect industry and employment conditions at that time and may not accurately reflect future industry conditions. While generally good indicators when based on fairly recent information, older multipliers can be dated and may not reflect industry conditions at the time of analysis. In any impact analysis, the information should be considered as indicators of size.
- **Employment coefficients** — employment impacts associated with future harvest levels are calculated using employment coefficients (person-years per 1000 cubic metres). This approach assumes that the industry structure will be the same in future as it is today. While reasonably accurate in the short term, employment coefficients may change in future as a result of changing market conditions or production technologies, for example.
- **Timing of impacts** — employment impacts are shown to occur simultaneously with a change in the harvest level. While fairly accurate for the harvesting subsector, this may not be the case for the processing and silviculture subsectors of the forest industry. Also, indirect and induced impacts will likely occur over a longer period, as business and consumer spending levels adjust to changes in harvest levels.
- **Processing thresholds** — processing job impacts are unlikely to occur in direct proportion to harvest changes (i.e., a 10% harvest reduction may not lead to a 10% processing employment reduction). Impacts are more likely to occur stepwise related to processing thresholds. A processing threshold is the level of a mill's timber supply that, when reached, will cause a mill to either lay off a shift or shut down the mill, temporarily or permanently. Accurately predicting a mill's threshold level is impossible. As a result, the analysis may overestimate processing impacts if mills continue to operate the same number of shifts, but perhaps at lower production levels, or alternatively could underestimate impacts if a mill were to eliminate a shift. Over the medium- to long-term the impact figures should be reasonably accurate.
- **Government expenditures** — provincial government expenditures are more related to population levels than to industry activity. As such, expenditures on education, health care and other government services are assumed to remain unchanged despite harvest changes and any subsequent change in government revenues. However, public expenditures would likely change if community population levels change sufficiently. This would amplify the community impacts of forestry job losses or gains.
- **Proportional harvest reductions** — harvest reductions are assumed to be spread proportionately among all licensees and all forms of tenure.

B.2 Economic Impact Analysis Methodology

Data sources

Data for the socio-economic analysis were obtained from several sources. Harvest volume and stumpage data are from the Ministry of Forests. Timber flow and employment data are from responses to questionnaires that were sent to licensees, operators and processing facilities in the TSA. Other general economic data are from B.C. Statistics, Statistics Canada and local communities.

Person-years of employment

The unit of measurement for employment is a person-year. A person-year of employment is defined as a full-time job, which lasts at least 180 days per year. Part-time jobs were converted to equivalent full-time person-years of employment. To estimate employment and income impacts associated with changes in TSA timber harvest levels, the forestry sector was divided into three subsectors:

1. harvesting;
2. silviculture; and
3. timber processing.

Estimating employment and income impacts involves several steps. First, the current activity in each of the three subsectors was assessed. Then, indirect and induced employment and employment income impacts were estimated, using data from B.C. Statistics and Statistics Canada. Next, employment coefficients were calculated and applied to the base case harvest forecast. Other indicators of the forestry sector's contribution to the provincial economy, such as government revenues and industry taxes, were also calculated, using Ministry of Forests stumpage estimates and other data sources.

Employment — harvesting

Direct employment in harvesting consists of all woodlands-related jobs including harvesting, log transport, log salvage, planning and administration functions. The employment multipliers used in this analysis define road building and maintenance work as indirect rather than direct employment. Including this employment in direct estimates would result in double counting.

Data on employment, place of residence and timber flows were obtained through a survey of licensees and operators in the TSA. The information was then used to estimate employment averages associated with harvest changes and the proportion of resident *versus* non-residents who work in the TSA.

Two estimates of direct employment in harvesting were calculated:

1. TSA direct employment in harvesting consists of employees who are engaged in harvesting and related activities within the TSA and who reside in communities within the TSA; and
2. Provincial direct employment in harvesting consists of employees who are engaged in harvesting, as above, plus those workers who reside outside the TSA, but who come to the TSA to work in harvesting and harvesting-related activities.

The estimates of TSA and provincial direct employment in harvesting were used to calculate employment coefficients per 1000 cubic metres. These employment coefficients were then used to estimate harvesting employment associated with the different harvest levels in the base case forecast.

Employment — silviculture

Silviculture employment consists of all basic and intensive reforestation activities, including surveys, site preparation, planting, fertilization, pruning and spacing. Silviculture employment data were collected from the Ministry of Forests and licensees whose tenures require post-harvest silviculture work. Most silviculture work is seasonal and silviculture employees usually only work part-time during the year. Because of this, silviculture jobs were converted into equivalent full-time person-years of employment. Respondents were also asked to estimate the percentage of their silviculture employees who resided within the TSA and outside the TSA.

As with the harvesting subsector, two estimates of direct employment in silviculture were calculated: one for the TSA and another for the province. These employment figures were used to calculate employment coefficients for silviculture employment in the same manner as the employment coefficients for harvest employment.

Employment — timber processing

Information about employment, production and sources of timber was gathered from TSA mills. Information was also gathered as to whether timber harvested from the TSA was processed within the TSA or outside the TSA. This information indicates the degree of dependence the mills have on timber harvested within the TSA. To estimate the share of processing employment supported by TSA timber, mill employment was prorated by the relative contribution of timber from the TSA to a mill's total timber requirement. For example, if 80% of a plant's timber requirement was supplied by the harvest from the TSA, then 80% of the employment in the plant would be attributable to the TSA harvest.

Employment figures were also adjusted to reflect the residences of workers: those who lived within the TSA and those who lived outside the TSA. Employment in timber processing that is supported by chip by-products from milling operations was also estimated similarly.

As with the harvesting subsector, two estimates of direct employment in timber processing were calculated: one for the TSA and another for the province. These employment figures were used to calculate employment coefficients for timber processing employment in the same manner as the employment coefficients for harvest employment.

Indirect and induced employment estimates

Indirect employees associated with the forestry sector are those who supply goods and services to firms directly engaged in the basic forestry sector, such as those who provide road maintenance services, fuel and office equipment and products. Induced employees consist of those who supply goods and services purchased by employees who are directly and indirectly engaged in the industry, such as those who work in retail outlets. Indirect and induced employment figures were calculated using TSA and provincial employment multipliers.

Two sets of employment multipliers were used for this report: migration multipliers and no-migration multipliers. The migration multipliers assume that displaced workers will leave the region, reducing total income in the region by their full wage. The no-migration multipliers assume that a displaced worker remains in the area, at least in the short term, and unemployment and other social safety net payments temporarily offset some of the income loss. Using the no-migration multipliers diminishes the induced impacts associated with a change in direct employment.

B.2 Economic Impact Analysis Methodology

The TSA and provincial employment multipliers used in the Kingcome TSA analysis are shown in Table B-1.

Table B-1. Total employment multipliers

Forestry subsector	TSA migration multiplier	TSA no-migration multiplier	Provincial coastal migration multiplier	Provincial coastal no-migration multiplier
Harvesting	1.45	1.34	2.02	1.72
Solid wood processing	1.31	1.25	2.31	1.94
Pulp	1.64	1.52	2.54	2.13

Sources: Horne, G., R. Riley, L. Ransom, and S. Kosempel. 1996. A provincial impact estimation procedure for the British Columbia forest sector.

B.C. Ministry of Finance and Corporate Relations. 1999. The 1996 forest district tables.

Employment estimates of alternative timber supply levels

To estimate employment generated by alternative timber supplies, the forecast harvest level is multiplied by the calculated employment coefficients. Note that employment coefficients are based on current industry productivity, harvest practices and forest management assumptions and will not likely reflect industry operating conditions in the future. Therefore, the employment estimates should be viewed as indicators of the size of change rather than as precise estimates of changes in employment levels.

Estimates of employment income

Employment income was calculated using average income estimates for workers in the forest industry. Income data are from Statistics Canada annual estimates of employment, earnings and hours. From 1997 to 1999, the average pre-tax annual income (less benefits) for subsectors of the forestry sector associated with the Kingcome TSA was about $46,800 for logging and forestry services; $46,200 for solid wood manufacturing; and $55,900 for the pulp and paper sector. The weighted average annual income for direct forestry workers in the Kingcome TSA was $47,125. The average annual income for indirect and induced employees averaged about $30,800. This figure is based on data for all service-producing industries from the Statistics Canada Labour Force Survey, B.C. Industrial Comparison, average weekly wage rates. Income taxes were calculated based on marginal tax rates of 23–28% with one-third of the total income tax accruing to the province.

B.2 Economic Impact Analysis Methodology

Provincial government revenues

Except for stumpage and rents, which are specific to the TSA, provincial government revenue impacts were estimated by using industry averages. Revenues per 1000 cubic metres of harvest, expressed as dollars per 1000 cubic metres, were calculated and applied to the harvest levels in the base case forecast in a manner similar to how employment impacts were estimated. Table B-2. summarizes provincial government revenue estimates.

Table B-2. Estimates of provincial government revenue — Kingcome TSA

Source of revenue	Average revenue 1998–2000 ($1999 millions)	Revenue ($/'000s m^3)
Stumpage, rents and royalties[a]	31.0	27,730
Industry taxes[b]	10.1	9,037
Provincial income tax[c]	8.4	7,531
Total government revenues	49.5	44,298

(a) Ministry of Forests.

(b) PricewaterhouseCoopers.

(c) Based on marginal tax rates from Revenue Canada.